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THE

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TRADE UNION LAW.

THE case of Quinn *v.* Leatham and Others, which was heard in the House of Lords on Monday last week, is one of the most important of a long series of decisions, which, in recent years, have tended to modify the existing law relating to trades unions. Ever since the famous decision in Allen *v.* Flood, employers have been under the impression that in persuading workmen to leave their employers, trade union officials have been guilty of no actionable wrong. They have also been under the mistaken belief that when a master is subjected to threats and intimidation the trade union Acts have deprived him of all redress. That these beliefs and impressions are entirely without foundation is clearly proved by the case above referred to.

The facts of the case, which was originally tried before Lord Justice Fitzgibbon and a jury at the Belfast Summer Assizes in 1896, were as follows:—The plaintiff, who was a butcher at Listrom, in the county of Antrim, was required by the defendants, who were members of a trade union, called the Journeymen Butchers Assistants' Association, to dismiss from his employment some assistants who were not members of the defendants' trade union. He declined to do so, but subsequently attended a meeting of the defendants' association, and asked to have his employés admitted to the union, offering to pay all fines and demands against them. The defendants refused to accept this offer, unless some of the plaintiff's employés were punished by being left out of work for 12 months. This the plaintiff refused to do. The defendants thereupon endeavoured to induce some of the plaintiff's employés to leave his service, and succeeded in inducing one of them to do so in breach of his contract of service. The defendants also gave notice to one Munce, a butcher in Belfast, with whom the plaintiff had had large business dealings for 20 years, that, unless he ceased to deal with the plaintiff, they would call out his employés. Munce telegraphed to the plaintiff not to send any more goods, and in the result the plaintiff's business was practically ruined. He therefore brought an action against the defendants (1) for maliciously and wrongfully procuring certain persons to break contracts into which they had entered with him, and not to enter into other contracts with him; (2) for maliciously and wrongfully enticing and procuring certain workmen in the employment of such persons to leave the service of their employers, and to break their contracts of service, with intent to injure the plaintiff, and to prevent such persons from carrying out their contracts with the plaintiff, and from entering into other contracts with the plaintiff, and for maliciously and wrongfully intimidating such persons, and coercing them to break their contracts with the plaintiff, and not to enter into other contracts with the plaintiff, and intimidating such servants in their employ, and coercing them to leave the service of their employers, to the injury of the plaintiff, and for unlawfully

conspiring together with other persons to do the acts aforesaid with intent to injure the plaintiff.

Certain questions were left to the jury, in answer to which they found (1) that the defendants had maliciously persuaded the plaintiff's customers to leave him ; (2) that the defendants or two or more of them did in fact conspire together to induce the plaintiff's servants to leave him ; and (3) that the defendants published a black list with intent to injure the plaintiff in his business, and that such publication did, in fact, injure him. They assessed damages against all the defendants at £200, and as against those defendants who had published the black list they laid damages at £50.

In these circumstances the learned judge who tried the case entered judgment for the plaintiff, and the defendants appealed to the Irish Court of Appeal. That Court dismissed the appeal, and the case was accordingly brought before the House of Lords for final consideration. In the course of a judgment in which he moved that the appeal be dismissed, Lord Halsbury said : "In this case the plaintiff has by a properly drawn statement of claim, complained of the defendants to a jury that the defendants have wrongfully and maliciously induced customers of the plaintiff to cease to deal with him ; that the defendants did this in pursuance of a conspiracy formed among them ; and that in pursuance of the same conspiracy they induced servants of the plaintiff not to continue in the plaintiff's employment ; and that all this was done with malice in order to injure the plaintiff. If, upon those facts so found, the plaintiff could have no remedy against those who had thus injured him, it could hardly be said that our jurisprudence was that of a civilised country."

The Lord Chancellor and Lord Lindley both drew a sharp distinction between this case and Allen *v.* Flood. There the defendants simply warned the plaintiff's employer of what the men themselves, without his permission, had determined to do. It was also an element in that decision that there was no case of conspiracy or even combination. What was alleged to be done was only the independent and single action of the defendant, actuated by the desire to express his own views in favour of his fellow workmen. In the case under notice, however, there was evidence of conspiracy in its most aggravated form, even to the extent of persuading a man, who for 20 years had been on good terms with the plaintiff, to cease having anything to do with him.

It is interesting to consider this momentous judgment in connection with the Electrical Trades' Union, the rules of which were published in the Review for March 1st, 1901.

Hitherto unions have been pleased to declare that the wireman must not perform single-handed the few simple operations necessary to finish a wiring job satisfactorily. The joiner must be called in to bore a hole in wood of a certain thickness ; the carpenter must be summoned to do any work of which the monopoly is claimed by his union ; while if a "wiped joint" becomes necessary, the plumber must be on hand to undertake the job. All these rules have been strictly enforced by threats of strikes ; if the contractor dare to permit a wireman to do more than the union allows, he is at once threatened with all the pains and penalties to which Mr. Leatham was subjected. It seems that we are approaching the end of this reign of terror. Hundreds of wiremen can be found who are quite competent to complete their job from start to finish. Suppose a contractor employs a man of this kind at some future time. What will be the result ? The union will send its emissary to ask him to stop working ; but the employer may simply answer, "You are the representative of a band of conspirators, who have no right to interfere with me, and I care nothing for your threats." We may be wrong in surmising that the decision of the House of Lords will carry the matter as far as this, but we feel confident that if there is any doubt upon the question, it will soon be dissolved by a test action.

Let us summarise, in a few words, the result of some of the recent decisions which have materially curtailed the powers of the unions :—(1) In Lyons *v.* Wilkins, the Court granted an injunction to restrain picketing ; (2) in Linaker *v.* Pilcher Mr. Justice Matthew held that the members of a union can be made liable to an action for libel, and that the funds of the union can be attached for the purpose of obtaining damages ; (3) in the Taff Vale Railway case, which was duly noted in these columns, the House of Lords decided that a union can be sued in its corporate capacity for "tort," and that the funds of the union may, in this case also, be drawn upon ; (4) the case of Leatham *v.* Quinn whittles down the effect of Allen *v.* Flood by declaring that, although an act may be lawful when done by one person, yet several persons may be held liable for conspiring together to do that act.

We shall be surprised if the unions do not ask for legislative interference with these drastic decisions.

Goliath Cranes.—An illustrated article written by Mr. J. Horner appeared recently in *Cassier's Magazine* describing a number of cranes of different designs and makes. At the commencement of the article a good deal of space is taken up with an elaborate definition of "Goliath" and "Gantry" cranes. This seems hardly necessary, as such machines are not dealt in so frequently and in such large quantities as to require a short definition to expedite transactions. One does not ask for half a dozen 25-ton Goliaths or a dozen 30-ton Gantries with the idea of taking them home at once. It is more usual to have a complete specification and numerous discussions, at the conclusion of which everyone concerned knows exactly what the contemplated machine will be, whatever name it may be called. The author next describes the methods of construction adopted for the framings of cranes, pointing out the relative advantages of timber and steel plate and angle work, and indicating the precautions required to avoid cross-working and consequent strain. After some remarks on general construction, short descriptions are given of some of the cranes illustrated. Some very good illustrations accompany the article, and really convey more information than the letterpress, the author's descriptions being very meagre, especially with respect to figures. The only crane of which anything like complete figures are given is one by the Wellman-Seaver Company, in which the span is stated to be 200 ft., travelling speed 200 ft. per minute, crab traverse 400 ft. per minute (which looks like a misprint), hoisting speed 20 ft. per minute. The powers of the three electric motors are stated, but the weight of the crane, and the load it deals with, are omitted. As may be gathered from the above remarks, the article is not overloaded with technical information, and so will be appreciated by anyone wanting a little light reading.

A NEW METHOD OF LOCALISING A FAULT IN A SINGLE CABLE.

By WALTER BETTS.

Of all tests for the localisation of faults in submarine cables, the loop test is universally admitted to be the most accurate, and, a test approaching it in accuracy and simplicity, when a second cable is not available, is undoubtedly the greatest desideratum of those engaged in such work. The method herein described will be found to possess these conditions to a greater extent than any other method yet published.

If a circuit is arranged as shown in the following diagram (fig. 1), the deflections on the two galvanometers will be in exact proportion to the resistances in circuit on their respective sides of *f*, and any change made on one side will produce a corresponding effect on the other.

We have at *f* the same conditions as in the loop test.

The *apparent* resistances, owing to the mutual opposition of the currents from the two ends, will be considerably higher than the *actual* conductor resistance in circuit

Fig. 1.

(dependent upon the E.M.F. employed, and the resistance of the fault), but as the apparent and the actual resistances always maintain exactly the same relative proportions to each other, the former can be used for the purpose of calculation.

The connections at A and B being suitably arranged, let both stations at a given time apply their currents, then (clocks being previously synchronised to a second, or even less, and time allowed for shunts to be adjusted in order to obtain convenient deflections) at pre-arranged moments note the deflections on their respective galvanometers. Each simultaneous pair of readings so obtained can be calculated by the formula given below. The observations at each end should be carefully numbered in their respective order so that they can be accurately paired for calculation,* then

L being = the normal C.R. of the cable r and r^1 representing the resistances of shunted galvanometer, battery and earth at A and B.

a ,, = the resistance required to represent the deflection at A.

b ,, = the resistance required to represent the deflection at B.

the distance of the fault x will be

from A

$$x = \mathrm{L}\frac{a}{a+b} - r;$$

from B

$$x = \mathrm{L}\frac{b}{a+b} - r^1.$$

A great number of experimental tests upon old artificial lines, and with various complex faults have given either absolutely exact or remarkably near results. In actual trials on long submerged cables very superior results have also been attained.†

* The following table illustrates the value of calculating each pair separately, also the progressive symmetrical relations existing between *a*, *b*, and *f*, with a rising or variable fault resistance.

No. of pair.	L.	Approximate resistance of fault.	"Apparent" resistance. *a.*	"Apparent" resistance. *b.*	Known distance from A in ohms.	Distance by test in ohms.	Difference in ohms.	Remarks.
1	3,940	700	2,990	1,707	2,474·6	2,481	6·4	
2	,,	1,500	4,315	2,431	,,	2,482	7·4	
3	,,	2,350	5,524	2,980	,,	2,512	37·4	Rejected.
4	,,	3,900	7,861	4,386	,,	2,466	8·6	
5	,,	5,000	9,863	5,386	,,	2,474·8	0·2	
6	,,	9,000	17,288	8,600	,,	2,474·5	1·1	

† In 1893 and 1894 two faults of the class called "phantom" were localised within 4 and 9 nauts respectively, each by a single series of tests by this method. The nearest results otherwise obtained during innumerable attempts by different persons using all other known and available methods, and extending over several months, were not within 17 and 93 nauts of the positions, and hardly any two tests agreed. The resistance of the fault of 1894 varied from about 7,000 ohms to 20 megohms, and at the time of the above series was about 24,000 ohms. During one of its high resistance periods a break of the conductor 300 miles beyond was localised by capacity test across this fault. Length of cable 2,300 nauts.

In 1895, in another cable of 840 nauts and 14,000 ohms conductor resistance, a fault presenting exceptional localisation difficulties was placed by one series of 11 pairs of readings by this method at 430 nauts from the end. A week later the mean of 6 pairs gave 427 nauts. The following week a set of 9 pairs gave 406 nauts. As no local cause could be found to account for the latter result, it was concluded that a second fault had occurred in the cable—although the duplex, balanced to the known fault, failed to show it.

A month later a vessel reported having hooked, and with great difficulty released, the cable on a date between the second and third tests. Subsequently a fault was taken out at the spot indicated by the vessel. Immediately afterwards the mean of a series of 10 pairs of readings placed the original fault at 428 nauts. More recently tests by other methods to which the fault had at length become amenable, fully confirmed the preceding results.

The insulation of these cables was not homogeneous throughout. No preliminary cuts for the purpose of circumscribing the faults were made—the whole lengths of cable from station to station were in circuit—the tests were mainly experimental with uninitiated or unpractised co-operators, also, the strong earth currents peculiar to the cables in those latitudes were very troublesome.

D

Results obtained by this method can be advantageously used as a check upon those obtained by the ordinary loop test, the second cable being utilised for the purpose of assuring simultaneity of observation, speaking, &c.

Only half the length of cable being under test, a corresponding gain is experienced with regard to quickness of distribution of charge, lower resistances and diminution of earth-current effects.

The readings being taken simultaneously, it is independent of the variation of the fault resistance.

No equilibrium has to be obtained.

It is not necessary to add resistance for the purpose of "centralising" the fault. I have shifted experimental faults into all sorts of unequal positions without interfering with the concord of results.

No comparison or unification of instruments or deflections is required. Any good galvanometer will do.

It is as simple as the ordinary deflection or substitution test.

A large number of distinct tests can be rapidly made.

In using the substitution method of testing, it is advisable to ascertain the equivalent resistances by calculation from a well-established constant, rather than by reproduction.

If any earth-current be present, and the tests cannot be postponed, it would be advisable to take *minute* or other distinctly separated readings, so that time before and after each pair can be given to observing the earth current or cable zero. It is indeed preferable at all times to take the cable zero, as it and the instrument or short-circuit zero seldom agree. The last zero reading before the test, and the first immediately following it, give the nearest indication of the state of the cable during the test. The cable zero should be arranged at a sufficient distance behind the scale zero to prevent confusion with regard to addition to or subtraction from the latter.

The batteries employed at the respective ends must be of the same kind, and, as near as possible, of equal E.M.F., the voltage being as low as conveniently practicable. In the event of a slight unavoidable known difference, a correction can be made. This method could be advantageously employed by one station upon two cables (fig. 2). The whole of the

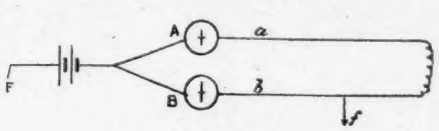

Fig. 2.

proceedings would then be within the control of one person, there would be a veritable loop test by deflection method, no balancing would be necessary, only one battery would be used, and simultaneity of observation would be assured.

The following notice of an actual test, typical of many

others giving true results, may suggest to mathematicians the value of a further investigation of the method.

Taking a test where L was = 3940 ohms
The observed or apparent resistance of a = 9863 „
The observed or apparent resistance of b = 5286 „
The distance from A $\left(\text{L}\ \frac{a}{a+b}\right)$ was = 2,565·19 ohms
and distance from B ... = 1,374·81 ohms
then (a) 9,863 − 2,565·19 = 7,297·81 ohms = apparent res. of fault on a side,
and (b) 5,286 − 1,374·81 = 3,911·19 „ = apparent res. of fault on b side.

The fault had actually a resistance of about 5,000 ohms.

From the following diagram it will be seen that the sections of the line, a and b, represent the fixed resistances of a Wheatstone bridge, and the apparent resistance of the fault, or the current flowing through it, distributes itself in proportion to the resistances of a and b, thus forming the third and fourth sides of the bridge.

so that we get $\frac{a \times b'}{b} = a'$ (and *vice versâ*).

The fact of the principle of the Wheatstone bridge being involved suggests that it may be possible to devise a means of *proving* the correctness, or otherwise, of results obtained —the resistances of the line composing the branches a and b being accurately known.

As a step in the direction of proof, the following is suggested in connection with the foregoing method.

Say, for 4,373 ohms of known line resistance there are 10 volts employed at each end, that is, $\frac{20}{4373} = \cdot00457$ ampere = C for each unit of known resistance in circuit; then, if the "apparent" fault resistances are correctly determined, the multiplication of C by their sum should give a voltage bearing the same proportion to 20 that the "apparent" fault resistances bear to 4,373, and the nearer this is attained the nearer accuracy is approached. It seems to the writer that it would be, at least, an aid to the judgment in the process of selection and rejection of tests.

NOTE ON A THEOREM IN ROTARY FIELDS.

By ALBERT CAMPBELL, B.A., A.M.I.E.E.

In an appendix to my paper on "Test Room Methods of Alternate Current Measurement," recently published, I proved a theorem which is, I believe, new. As the matter seems of some practical importance in connection with alternate current motors, as well as measuring instruments, I write the following note for the purpose of explaining and illustrating the mathematical result which I obtained. The theorem may be stated briefly as follows:—

If two alternating fields, A and B, of equal effective values and any wave-forms be inclined to one another at an angle equal to the supplement of the "power lag" between A and B, then the resultant rotary field will have a constant effective value in all directions perpendicular to an axis of rotation.*

I should, perhaps, remark that in the special case where the wave forms of A and B are both sinoidal, the theorem has been well known for many years. In practice, however, it is usually impossible to assume sinoidal wave forms; in the familiar case of the usual starting device of an alternate current motor, where the phase is "split" by means of inductance or capacity, it is too much to expect even similar wave forms in the two fields whose resultant is rotary, and for such cases the general theorem is necessary.

To illustrate the theorem graphically, I have taken (in fig. 1) the wave forms of A and B sinoidal and triangular

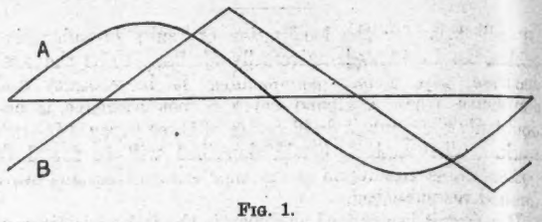

Fig. 1.

respectively; their effective values are equal, and B has a *time lag* of 60° behind A. The power lag, ϕ, between A and B, is found to be approximately 60·2°. If A and B now be inclined in space to one another at an angle $\pi - \phi$, the result is given in fig. 2, where I show, drawn to scale, the forms of

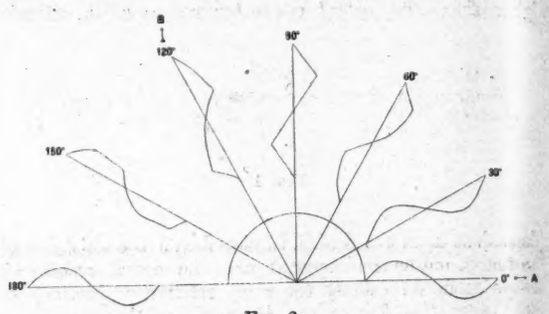

Fig. 2.

the resultant alternating field in a number of directions. Although it will be noticed that the wave form of the field is very different for different directions, the above theorem shows that the effective values for all the curves are equal. My friend Mr. F. E. Berry, whom I have to thank for kindly drawing the curves for me, has calculated by Mr. Alexander Russell's graphical method (see *Electrician*, Vol. XXXV., p. 115), the effective values from the curves, and has obtained the figures 1,000, 1,003, 1,008, 1,006, 1,007 and 1,000. These figures corroborate (if that were necessary), the theorem, but I give them rather as an illustration of the degree of accuracy attainable by the graphical method used.

* By "power lag" I mean the angle whose cosine is the power factor.

SMOKY FURNACES, AND HOW TO AVOID THEM.

By W. H. BOOTH.

(*Continued from page* 179.)

In the vertical form of water-tube boiler, of which the Stirling boiler is one of the best known examples, the tubes are very long and nearly vertical, and the grate is placed at the bottom of a high chamber contained between three refractory walls—viz., the front cross wall of the boiler, the two side walls, and the first rows of tubes, with brick-casing tiles on the row furthest from the fire, while the upper part of this chamber serves as a combination chamber. Thus, though the gases rise from the furnace in a vertical direction they have a considerable distance to travel, during which they may become mixed with any air admitted at the door, and there is a considerable space for combustion. There is, of course, no reason why the slab of firebricks marked A in fig. 8 should not be threaded upon the first row of tubes next the fire, so that the whole four walls would be refractory, and smokelessness would be more certainly effected. In fig. 8 the furnace of this boiler is shown, together with the first nest alone of nearly vertical tubes. In an ordinary size of this boiler there will be two lower and three upper drums

and three sets of tubes. The nearly vertical position of the tubes enables them, though of small diameter, easily to carry the layer of firetiles, and there does not appear any reason why, should it seem to be desirable, these firetiles should not be placed on the first tube, as shown by the dotted lines, instead of on the fourth set, as at A.

The principle of smokelessness is perhaps most thoroughly carried out as regards water-tube boilers in the case of the

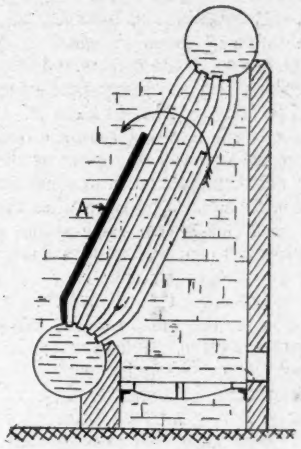

Fig. 8.

Weir boiler. This is of the small tube variety, and is marked by the fact that the design has been rather contracted to its present dimensions from larger sizes than expanded from small and inefficient dimensions. Mr. Weir began the water-tube battle with two ideas, the one that a bituminous coal could only be smokelessly consumed when its gases were maintained at a high temperature, and the other that, given that high temperature, there must be allowed ample space for combustion to complete itself prior to exposing the gases to the chilling effect of the tubes. Having thoroughly grasped these fundamental ideas, he decided to start out in a fully liberal allowance of space, irrespective of how much space the boiler then occupied, arguing that the first elements of success should rather be perfect combustion and efficiency than minimum space and weight, at which alone so many boiler designers had aimed. Then having secured a boiler which filled the requirements, it remained, still adhering to correct principles and forms, to reduce space and weight and volume to such a minimum as would still command the necessary good qualities. The necessary element of temperature was secured by thoroughly casing the walls of the furnace in brick.

The skeleton of the furnace walls consists of a single row of tubes in the form of a ∧ but without the apex, and these tubes were cased as in fig. 7. Above a certain level the blocks are left off, and afford access for the gases to pass to the combustion space, while still hot enough to continue burning, and the main body of tubes is only encountered when combustion is practically complete. In this boiler there thus exists a furnace of considerable breadth, the four sides of which are of brick; the side walls narrow the furnace space, and bring all the products of combustion to a narrow outlet into close companionship, and there are formed two zones of combustion so that space is fully utilised, and but little heat absorbing surface is placed in the path of the furnace products until well burned off. This is well shown in fig. 7A, where the boiler is shown in cross section, and the casings of firebrick are plainly seen together with the capacious combustion chambers enclosed between them. It is abundantly evident from this view that the fuel can be burned in the ordinary manner on the grate with the production of about three-fourths the total temperature of which the fuel is capable if bituminous. This temperature is conserved by the brick linings, and the gaseous products still hot are then burned in the combustion chamber, and pass away finally amongst the tubes. This point may appear to have been too much laboured. The excuse must be that after 100 years of steam engineering, there is nothing in ordinary practice to show that the general appreciation of the subject of combustion is in advance of the practice and knowledge of the time of Watt.

It will be observed that the firebrick casings of the Weir boiler are carried by tubes of larger diameter than the main body of the tubes, and that they are also widely spaced. Hence, though the brick liners do not quite cover the tubes the part not covered is very small, less than one-fifth of the total wall surface, in fact. This exposed area is insufficient to reduce the temperature of the gases below combustion point, and is indicative of the good results that might be expected were internally fired boilers of the Lancashire type partially incased in their furnace parts by arches of firebrick. It is at least satisfactory to find correct principles so fully carried out in construction as we find them in the Weir small tube boiler. Another point to be noticed in this boiler is that when the gases pass from the furnace to the combustion chamber they have only to pass by a single row of tubes, and these widely spaced. There is not a bank of several tubes to be encountered whereby the gases would be exposed to a considerable area of cold tube surface just as they passed to the critical point in the combustion chamber.

In the Haythorn boiler (fig. 9) there is formed a combustion chamber very similar in general arrangement to that of the Babcock & Wilcox, but the roof is made continuous,

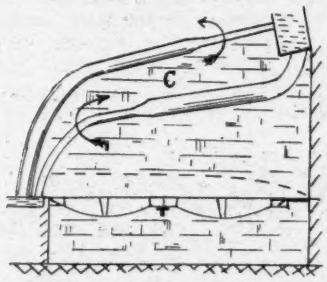

Fig. 9.

not by slabs of firebrick laid on the water-tubes, but by making these particular tubes so large as to touch each other, and so form a surface without openings, the opening from the furnace to the combustion chamber and thence out again amongst the general body of the tubes, being formed by reducing the tubes along a sufficient length to provide the needed area for passage of gases.

This boiler would be very fairly suited for short-flaming coals, but for a coal of the longer flaming type the cold furnace roof might cause smoke. In such a case, instead of the large tubes reduced at the ends, the tubes next the fire could be made small throughout their full length and encased in firetile, as in other cases, so completely surrounding the furnace with hot walls, in which case this boiler would be rather an ingenious adaptation of the water-tube system with correct form of furnace and combustion chamber.

It is unnecessary to take other examples of water-tube boilers to illustrate types in which smoke prevention either has or has not been attempted. Some water-tube boilers, designed for smokeless coal, do not require such provision and need not be here considered, as they lie outside the scope of this article, the object of which is to show why smoke is made, how its prevention has been attempted under ordinary conditions, and why the attempt has failed, and how the water-tube boiler has been in cases designed with a view to smokelessness. There is, of course, no absolute reason why the water-tube boiler should produce so much smoke, but it is perfectly obvious that, when designed so that the products of combustion pass in lines perpendicular to the grate surface by a short path between water tubes, smoke is inevitable. But, as shown in the Weir boiler, to take one of the examples I have selected in which the principles of combustion receive recognition, the water-tube boiler can be designed of such proportions and in such shape as to embody the essential points, and these points are best embodied by following out the principle of over sufficiency as done by Weir, for it is always easier to bring down dimensions than to be compelled to make more liberal provision upon an initially insufficient design. If the problem of steady and

reliable water feed could be thoroughly mastered in connection with water-tube boilers, there is nothing to prevent them being a success as regards combustion. The extreme smokiness of the Belleville type arose, of course, from the direct admission amongst the cold tubes of the gases from the fire, and the unscientific design of this particular boiler is such that a smokeless furnace could hardly be applied within a reasonable space.

(*To be continued.*)

METHODS OF COMMUNICATION IN ELECTRIC GENERATING STATIONS.

A VERY large proportion of the accidents which occur in electric generating stations is due either to attention not having been drawn in time to certain occurrences, or to insufficient means of communication between charge engineers and their men. That this is so does not necessarily reflect discredit on those responsible for the design or management of these stations, as the supply of electricity is so decidedly a "hand-to-mouth" concern, that means of observation and communication must be very efficient in order to ensure success. Under these circumstances it is interesting to note the various methods of signalling and communication in vogue in such stations. For the purposes of this article a signal may be defined as a device or motion that gives notice or conveys information in a prominent manner.

In a small station the plant is usually grouped closely together, well under the observation of the engineer in charge of it. The men are also few in number, are close at hand, and are generally well in touch with their chief and their work. In these stations the need for signals is small, as the necessary information can be gained from direct observation of the machinery and measuring instruments, and conveyed by word of mouth. As a station grows in size, however, it becomes more and more necessary that information should be conveyed to a common centre, from which centre instructions should be sent out again. This is imperative if any one man has to assume responsibility for the running of the plant. In this way automatic and manipulated signals become of increasing necessity as the station grows larger. It is intended in this article to describe a few of the signalling arrangements which have been adopted in various large stations.

It will be well to consider, first, those signals which draw attention to occurrences; and secondly, those which convey instructions. It is, however, necessary to remember that there is no distinct division between the classes.

It is frequently the case in large stations that while care has been taken in the design to have engines and boilers conveniently placed for observation and working, other parts of the plant, no less important, are crowded away into odd corners in order to economise space. This particularly applies to water tanks, such as hot wells, reserve feed water supply, or circulating water reservoirs in connection with cooling towers. The failure of supply from these tanks would mean disaster. Everyone knows the result of shortness of water in a boiler, and no station engineer will view the failure of condensing water on heavy load with anything but dismay. It is clear, then, that in addition to the ordinary water-level indicator a prominent signal should be given in the boiler house whenever the water is dangerously low in these tanks. A very effective device in use for this purpose is an electric contact in circuit with a battery and loud-ringing bell, the contact being actuated by a float on the surface of the water, and set so as to make connection when the float has sunk to a certain level.

In many modern generating stations quick-steaming boilers are in use. In these, the water-level is likely to rise and fall very rapidly, and unless careful attention be paid, the boiler may be ruined through shortness of water, or the steam pipes and engines may be wrecked through water coming over into them. It is therefore standard practice among boiler makers to include among their fittings a high and low water alarm whistle. The whistle is blown by steam from the boiler, this steam being admitted, both for high and low water, by the action of a float or floats in the interior of the drum. The fireman is thus warned to look more closely at the water gauges, a warning very necessary in a boiler house containing, perhaps, 20 or 30 gauges, probably well above eye level and insufficiently illuminated.

These two general methods—the electric bell signal or the steam whistle—are used in various special cases in connection with steam-raising plant, which cannot be entered into in detail here. A warning is, however, necessary against increasing the number of such signals indefinitely, either in boiler or engine houses. The drivers and stokers are paid to look after the plant, and too many precautions may give a false feeling of security. Also, in time of emergency confusion may arise in the minds of the men owing to a multiplicity of automatic signals being given at the same time.

Trouble has occasionally ensued because steam and water valves have been thought to be open when they were closed, or *vice versâ*. For this reason some station engineers have taken the precaution to so arrange all important valves that they show conspicuously whether they are open or shut. Some valves have external threads which can be seen in one position and not in the other; others have guide-blocks which move with the valve. Whatever the indicator may be, it should be painted or otherwise made as conspicuous as possible. Where there is no external signal it is an easy matter to arrange one, geared or linked to the handle or valve stem. It does not appear to be a satisfactory plan to provide tablets to be attached by hand to the valve with "open" or "shut" upon them, owing to the probable negligence of the men.

It is, however, in the running machinery and electrical equipment more than in the steam-raising portion of the plant that the need for signals arises. Except in extreme cases, there is always a minute or two to put matters right in the boiler house. In dealing with the running machinery the time available to avert a catastrophe is often to be reckoned in seconds. As an example of the necessity of signalling arrangements in this work, the general practice may be mentioned of providing a synchronising lamp in full view of the drivers in alternating-current stations, so that they may run up their engines to exact speed without loss of time. A variation of this practice is adopted in some stations where alternating current arc lamps are used. Conspicuous marks are painted on the rotor of the alternator. When the machine is slightly under speed, these marks appear to revolve backwards. They appear to go forward when the speed is too high, and at exact synchronism they seem to stand still. In some single-phase high tension stations it is customary for the switchboard attendant to synchronise by means of a signal lamp instead of a voltmeter. Messrs. Siemens & Halske have devised an extension of this lamp signal (using three lamps) for three-phase work, by which one is enabled not only to tell when two machines are in phase, but also, if this is not so, whether the incoming machine is revolving faster or slower than the synchronising speed.

Another application of the incandescent lamp as a signal is found in the "earth" detector common in low tension two-wire stations. Two lamps are connected in series across the bus bars (which are normally insulated from earth) and a connection to earth is made from the wire joining the two lamps. Hence if both halves of the system be perfect, a current will flow through the signal lamps in series, causing them to burn with an equally dull red glow. If, however, there is an earth on either side, the lamps will be subjected to unequal pressures, and one will burn more brightly than the other. The "earth" is of course on the branch opposite to the brightly-burning lamp. This device has also been applied to the field circuit of high tension stations, when the machines are excited from a common source.

In high tension alternating current stations the following modification of the incandescent lamp signal has been adopted with some success. A Geissler tube is connected between the high tension cable and earth. So long as the pressure is maintained the tube shows a bluish light. Should the insulation break down, the light is extinguished. This is particularly useful in three-phase work, as one is

enabled to tell at a glance which of the three branches is at fault. The tube also incidentally solves a difficulty occasionally met with in practice—the fact that fuses sometimes fail very quietly, and therefore no attention is paid to the interruption of supply until complaints begin to arrive. In order to make the Geissler tube of value in this way, its point of connection should be on the cable side of the fuse—not between the fuse and the bus bar.

On a switchboard with a large number of distributing panels it is an easier matter than would at first sight appear to overlook the failure of a fuse. For this reason it is desirable, other things being equal, to adopt a fuse that makes a noise when it goes. Fuses which depend on the expansion of heated air within a fuse pot (either wholly or partially) to blow out the arc invariably make a bang when the fuse melts, the noise forming a signal to the attendant which cannot be disregarded.

In direct current work automatic circuit breakers are to a large extent replacing fuses, more especially in combined lighting and traction stations. These have a trick of coming out quietly, and an additional signalling device is useful where more than five or six cut-outs have to be watched. A very good method which has been adopted is to so arrange an auxiliary switch on the base of each circuit breaker that the thrust of the cut-out handle, when the contact is broken, closes the circuit of a bell and indicator system. The circuit breakers should be boldly numbered in conformity with the numbers of the indicator drops, and a reference table of circuit breakers and numbers kept beside the indicator board.

In low tension systems a ready means of signalling the failure of a fuse, where this is inconveniently placed for inspection, is to place an ordinary glow lamp in shunt with the fuse. At the failure of the fuse the potential of the cable in all probability drops considerably, while that of the bus bar remains the same. A current therefore flows through the lamp, due to the difference of pressure between its terminals, and the glow attracts the attention of the man in charge.

In high-tension stations, whether continuous or alternating current, there should be a permanent danger signal on all wires at high potential. This is usually effected by means of painting such wires a distinctive colour. This is not entirely satisfactory, as one is never sure whether the cable is really alive or not until one has traced the connections. The suggestion may perhaps be permitted that there is without doubt a fortune awaiting the man who invents a paint or other covering for a cable which can indicate by change of colour or otherwise when the potential of the cable which it covers exceeds the limits of safety to life. Unfortunately, there appears at present to be no clue upon which to work in this direction.

Turning now to the important class of signals designed to convey instructions, it will be found that the chief points inside a station between which rapid communication is necessary are the switchboard and engine room. This is particularly the case in alternating current stations, where the operation of synchronising has frequently to be performed in the utmost hurry; but it is also true for direct current stations. It will be found that nearly every station has its code of signals between switchboard attendants and drivers, often consisting in its simplest form of pointing with the finger at an engine and an upward or downward motion of the hand, varying in vigour in accordance with the amount of alteration required. This is enough for a small station, but quite inadequate in a large one. Perhaps the most legitimate outcome of this system can be seen at a station in the metropolis, where, after a preliminary whistle to attract attention, the deaf-and-dumb alphabet, with various supplementary signs, is used! *A propos* of this, it is well to remark that whistling or shouting in an engine room, except according to a pre-arranged plan, should be strictly put down.

In order to indicate which engine is to be run up, the signal in a large provincial station is a light board mounted on a handle with a figure painted prominently on it, this figure corresponding with the number of the engine. A gong is sounded to attract the attention of the drivers, the board is held up, and a motion of the other hand completes the message. Another useful method is to have a coloured lamp fixed to each engine, which can be lit by a numbered switch on the board when anything has to be done on that engine. A signal bell completes the equipment.

A rather more elaborate system is suitable for use in a station where the switchroom is partitioned off from the engine room. A large dial is fixed on the wall of the engine room, on which the numbers of the engines are painted in the manner of the hours on a clock face. A pointer moves round this dial, being actuated through bevel gear and iron rods by a handle in the switchroom. This handle moves round a similar horizontal dial, marked in the same way as the engine room dial, and the handle and pointer are so fixed that the same number is indicated on both dials. A similar pair of dials with "Slow," "Fast," "Right," "Stop," on them, and an electric gong to attract attention, completes the arrangement.

In stations where machines are run in parallel, it is very often the custom to run on the stop valve, the load being shifted on or off the engine by the driver opening or shutting the valve. At times of variation of load (such as on the "peak") a driver will have to be in constant attendance at the engine to open or shut the valve as required. In order to get perfect smoothness in the running, a very good system has been adopted of placing two bell pushes on a bench immediately below the main voltmeter, one actuating a high-toned, the other a low-toned bell. A stroke on the high-toned bell means that the driver is to give more steam to the engine which he is regulating. The other bell signals the reverse. Thus a man watching the voltmeter is able at once to give the necessary direction to the driver. The signal gong system has in some places been extended into an elementary code, one ring, for instance, meaning "attention," two rings "lower speed," &c.

It is very often necessary to give more complicated instructions than can be transmitted by the above methods. It is necessary, therefore, in large stations to have a more complete system of communication, such as is afforded by a telephone system. A station should be fitted with a private telephone exchange on the switchboard, the points to which communications are most frequently sent being connected with this centre. These points will generally be found to be the chief engineer's office, the mains superintendent's office, the boiler house, and the stores. It is a matter of some difficulty, however, to get a telephone to work well in a boiler house, owing to the amount of coal dust, moisture and ash flying about, and the liability to rough treatment from the works hands. The telephone should be fixed in a quiet place, and a loud-ringing bell used as a signal.

The mains department should also be fitted with a private telephone exchange communicating with the switchboard, the chief's office and each sub-station. The station should, in addition, be on the general telephone exchange of the town, and loud-ringing signal bells should be placed in the mains engineer's office and on the switchboard, in addition to the usual call-bell in the clerk's office.

It will in general be found a paying investment to equip a station with complete facilities for signalling and communication, provided that no unnecessary fads are indulged in.

THE MECHANISM OF THE ELECTRIC ARC.

By (Mrs.) HERTHA AYRTON.

(Communicated by Prof. Perry, F.R.S. Received June 5th; read June 20th, 1901.)

(Abstract.)

The object of the paper is to show that, by applying the ordinary laws of resistance, of heating and cooling and of burning to the arc, considered as a gap in a circuit furnishing its own conductor by the volatilisation of its own material, all its principal phenomena can be accounted for, without the aid of a large back E.M.F., or of a "negative resistance," or of any other unusual attribute.

The Apparent Large Back E.M.F.—It is shown how volatilisation may begin, even without the self-induction to which the starting of an arc, when a circuit is broken, is usually attributed; and it is pointed out that, when the carbons are once separated, all the material in the gap cannot retain its high temperature. The air must cool some of it into carbon *mist* or *fog*, just as the steam

issuing from a kettle is cooled into water mist at a short distance from its mouth. The dissimilar action of the poles common to so many electric phenomena displays itself in the arc at this point. Instead of *both* poles volatilising the *positive* pole alone does. It is considered, therefore, that the arc consists of (1) a thin layer of carbon vapour issuing from the end of the positive carbon, (2) a bulb of carbon mist joining this to the negative carbon, and (3) a sheath of burning gases, formed by the burning of the mist, and the hot ends of the carbons, and surrounding both. The vapour appears to be indicated in images of the arc by a sort of gap between the arc and the positive carbon, the mist by a purple bulb, and the gases by a green flame.

The flame is found to be practically insulating, so that nearly the whole of the current flows through the vapour and mist alone. It is suggested that the vapour has a high specific resistance compared with that of the mist, and that it is to the great resistance of this vapour film that the high temperature of the crater is due, and not to any large back E.M.F. of which it is the seat.

Volatilisation can only take place at the surface of contact between the vapour film and the positive carbon. When that surface is smaller than the cross section of the end of the carbon, it must dig down into the solid carbon and make a pit. The sides of the pit, however, must be hot enough to burn away where the air reaches them, hence there is a race between the volatilisation of the centre of the carbon and the burning of its sides that determines the shape of the carbon. When the arc is short, the air cannot get so easily to the sides of the pit, hence it remains concave. When the arc is long, the burning of the sides gains over the volatilisation of the centre, and the surface of volatilisation becomes flat, or even slightly convex.

The peculiar shaping of the negative carbon is shown to be due to its tip being protected from the air by the mist, and its sides being burnt away under the double action of radiation from the vapour film and conduction from the mist, to a greater or less distance, according to the length of the arc and the cross section of the vapour film.

It is shown that if the crater be defined as being that part of the positive carbon that is far brighter than the rest, then the crater must be larger, with the same current, the longer the arc, although the area of the volatilising surface is *constant* for a constant current.

By considering how the cross section of the vapour film must vary with the current and the length of the arc, it is found that its resistance, f, must be given by the formula

$$f = \frac{h}{\text{A}} + \frac{k + m\,l}{\text{A}^2},$$

where h, k, and m are constants, l is the length of the arc, and A the current. This is the same form as was found by measuring the P.D. between the positive carbon and the arc by means of an exploring carbon, and dividing the results by the corresponding currents. Hence the existence of a thin film of high resisting vapour in contact with the crater would not only cause a large fall of potential between the positive carbon and the arc, exactly as if the crater were the seat of a large back E.M.F., but it would cause that P.D. to vary with the current and the length of the arc exactly as it has been found to vary by actual measurement.

The Apparent "Negative Resistance."—As nearly all the current flows through the vapour and mist, the surrounding flame being practically an insulator, the resistance of a solid carbon arc, apart from that of the vapour, must depend entirely on the cross section of the mist. To see how this varies with the current, images of an arc of 2 mm. were drawn, with the purple part—the mist—very carefully defined, for currents of 4, 6, 8, 10, 12, and 14 amperes. The mean cross-section of the mist was found to increase more rapidly than the current, consequently its resistance diminishes more rapidly than the current increases. As the formula for the resistance of the vapour film shows that it too diminishes faster than the current increases, it follows that the whole resistance of the arc does the same, and that consequently the P.D. must diminish as the current increases. Hence if δv and δA be corresponding increments of P.D. and current, $\delta v/\delta \text{A}$ must be negative, although the resistance of the arc is positive.

It is found, from the above measurements of the cross-sections of the mist, that the connection between m, the resistance of the mist, and the current, is of the form,

$$m = \frac{\alpha}{\text{A}} + \frac{\beta}{\text{A}^2}.$$

If m varies directly with the length of the arc, then

$$m = \left(\frac{\alpha}{\text{A}} + \frac{\beta}{\text{A}^2}\right) l.$$

Adding this equation to (1), we get

$$f + m = r = \frac{p + q\,l}{\text{A}} + \frac{s + t\,l}{\text{A}^2}$$

for the whole resistance of the arc, which is exactly the form that was found by dividing direct measurements of the P.D. between the carbons by the corresponding currents. Hence there is no reason why this ratio should not represent the *true* resistance of the arc.

Under what Circumstances $\delta v/\delta \text{A}$ Measures the True Resistance of the Arc.—When the current is changed it takes some time for the vapour film to alter its area to its fullest extent, and still more time for the carbon ends to change their shapes. All the time these changes are going on the resistance of the arc, and, consequently, the P.D. between the carbons, must be altering also. Both these, therefore, depend not only on the current and the length of the arc, but also, till everything has become steady again, *i.e.*, till the arc is "normal" again, on how lately a change has been made in either. At the first instant after a change of current, before the volatilising area has had time to alter at all, δv and δA must have the same sign, just as they would if the arc were a wire, but as the volatilising surface alters, the sign of δv changes. If, therefore, a small alternating current is applied to the direct current of an arc, it will depend on the frequency of that current whether $\delta v/\delta \text{A}$ is positive or negative. When the frequency is so high that the volatilising surface never changes at all, $\delta v/\delta \text{A}$ will measure the true resistance of the arc unless it has a back E.M.F. which varies with the alternating current.

The measurements of the true resistance of the arc made in this way by various experimenters have given very various results, because probably the frequency of the alternating currents employed has been too low not to alter the resistance of the arc. A curve is drawn showing how the value of $\delta v/\delta \text{A}$ with the same direct current and length of arc varies with the frequency of the alternating current, and it is pointed out that even if the arc has as large a back E.M.F. as is usually supposed, the *true* resistance cannot be measured with an alternating current of lower frequency than 7,000 complete alternations per second.

The exact conditions under which the *true* resistance of the arc can be measured in this way are examined, and the precautions that it is necessary to take to ensure the fulfilment of these conditions are enumerated.

The Changes introduced into the Resistance of the Arc by the Use of Cored Carbons.—A core in either or both carbons has a great effect on both the P.D. between the carbons and the *change* of P.D. that accompanies a given *change* of current. It lowers the first, and makes the second more positive, *i.e.*, gives it a smaller negative or larger positive value, as the case may be. It is pointed out that this might be due to the influence of cores either on the cross-section of the arc, or on its specific resistance, or on both.

To see the effect on the cross-section, enlarged images were drawn of 2 mm. arcs with currents increasing by 2 amperes from 2 to 14 amperes, between four pairs of carbons, + solid − solid, + solid − cored, + cored − solid, + cored − cored. Two sets of images were drawn with each pair of carbons—the one immediately after a change of current, to get the "non-normal" change, and the other after the arc had become normal again. The mean cross-section of the mist was calculated in each case, and its cross-section where it touched the crater was taken to be a rough measure of the cross-section of the vapour film.

It was found that the mean cross-section of the mist with a given current was largest when both carbons were solid, less when the negative carbon alone was cored, less still when the positive alone was cored, and least when both were cored. Coring either the positive carbon alone, or both carbons, had the same effect on the cross-section of the vapour film as on that of the mist, but coring the negative alone only diminished this cross-section immediately after a change of current, but not when the arc had become normal again. Hence it was deduced that if the cores altered the *cross-sections* of the arc only, they would *increase* its resistance, and, consequently, the P.D. between the carbons. As they *lower* this, however, they must do it by lowering the specific resistance of the arc more than they increase its cross-section. The vapour and mist of the core must therefore have lower specific resistances than the vapour and mist of the solid carbon.

When it is the positive carbon that is cored, all the vapour and mist come from the *cored* carbon. When the negative, they come from the *uncored* carbon, and it is only because the metallic salts in the core have a lower temperature of volatilisation than carbon that the mist is able to volatilise these and so lower its own specific resistance.

The effect of a core in either carbon, or in both, must depend on the current, because the larger the current the more solid carbon will the volatilising surface cover, and the less therefore will the specific resistances of the mist and vapour be lowered. The way in which the core acts in each case is traced, and the alterations in the specific resistances and cross-sections due to the core are shown to bring about changes in the P.D. exactly similar to those found by actual measurements of the P.D. between the carbons. It is shown, for instance, how these changes entirely account for the fact established by Prof. Ayrton* that, with a constant length of arc, while the P.D. diminishes continuously as the current increases when both carbons are solid, it sometimes remains constant over a wide range of current, or even increases again, after having diminished, when the positive carbon is cored.

The alterations in the value of $\delta v/\delta \text{A}$ introduced by the cores are next discussed, and it is shown that the changes in the resistance of the arcs that *must* follow the observed changes in its cross-section, coupled with the alterations that must ensue from the lowering of its specific resistance, would modify $\delta v/\delta \text{A}$ just in the way that Messrs. Frith and Rodgers† found that it was modified by direct measurement. Thus all the principal phenomena of the arc, with cored and with solid carbons alike, may be attributable to such variations in the specific resistances of the materials in the gap, as it has been shown *must* exist, together with the variations in the cross-sections of the arc that have been observed to take place. Hence it is superfluous to imagine either a large back E.M.F. or a "negative resistance."

Aylesbury.—The D.C. has instructed Mr. Medhurst to report on the tenders received for lighting the town.

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* Electrical Congress at Chicago, 1893.

† "The Resistance of the Electric Arc," *Phil. Mag.*, 1896, vol. 42, p. 407.

did not admit that there was a single statement in the prospectus that was not a true one. The promoters absolutely believed in the truth of the statements, and were putting their own

a cycle factory and nothing else. He considered the company's patents for switches and fittings valuable at the time, as there had been a change from low to high pressure, and the patents met the

LEGAL.

Glynn *v.* Atherton.

From Thursday last week until Wednesday this week Mr. Justice Bucknill and a special jury were occupied in the Nisi Prius Court of the Liverpool Assizes hearing the case of Glynn *v.* Atherton and others. The plaintiff, Walter Glynn, a shipowner of Liverpool, sought to recover compensation from James B. Atherton and others, directors of the British Electric Works, Limited, for alleged misrepresentation in a prospectus relating to the company and the works. Liability was denied by the defendants.

Mr. Asquith, K.C., M.P., in opening the case, stated that the plaintiff, Mr. Glynn, was an original allottee of 500 preference shares and 500 ordinary shares in the British Electric Works Company, and claimed compensation from the defendants, who were the promoters and directors of the company, in respect of misleading statements in a prospectus, upon the faith of which he was induced to subscribe for his shares. The company was formed in April, 1899, and at the time of that inquiry the shares were practically worthless. Counsel proceeded to review the circumstances of the formation of the company, to acquire and carry on a business at the time under the name of R. F. Hall & Co., Limited, and traced the history of Hall & Co.'s business. Mr. Hall was one of the defendants in the action, as he was managing director of the British Electric Works Company. He had been largely interested in the cycle industry, and between the years 1894 and 1897 went into business under the style of R. F. Hall & Co., as manufacturers of cycle components at Sherlock Street, Birmingham. There was a large demand for the goods, and in February, 1897, the business was formed into a company, as R. F. Hall & Co., Limited, with a capital of £125,000. Mr. Hall received £25,000 for goodwill, and £25,000 for stock. A prospectus was issued which set forth that the company was formed to acquire the business of manufacturers of cycle parts and accessories carried on by R. F. Hall & Co. in Sherlock Street, Birmingham. Apparently, it was not contemplated to carry on any business but that of manufacturing cycle parts and accessories. New premises were erected in Cheston Road, and were ready in March, 1898. The failure of Mr. Hooley, and the "slump" in the cycle trade which followed, damaged the company, and a receiver was put in possession on behalf of the debenture holders. An attempt had been made to place some electric lampholders on the market, but this had not been successful. In January, 1899, the shareholders decided to voluntarily wind up the company. A liquidator was appointed, and he sought a purchaser for the business. An agreement was entered into with Mr. J. B. Atherton, managing director of the British Insulated Wire Company, at Prescot, a prosperous concern, for the sale of Hall & Co.'s business to him for £55,000. Two months later the property was sold by Atherton to the British Electric Works Company for £142,000. The debenture holders were paid in full; the unsecured creditors received 3s. 6d. in the pound, and the shareholders got nothing. The new company acquired three electrical inventions of Mr. Hall's, but these proved of no value. The public were asked to subscribe for what was described as a flourishing engineering and electrical business, when what they were really acquiring was an insolvent cycle business. One of the directors was Alderman Higginbottom, of Cheadle Hulme, Manchester, chairman of the Electricity Committee, the whole object of the prospectus appearing to be to impress upon the mind of the public that the company was a good electrical engineering concern. There was also Mr. Brigg, chairman of the British Insulated Wire Company; Mr. Goffey, of Liverpool; Mr. Jacob Atherton; and Mr. Hall. Mr. J. B. Atherton was the promoter. The prospectus was launched in an absolutely reckless way. According to the prospectus, the works and machinery were valued at £105,888, and stock was estimated to be worth £5,000. The working capital of £43,000 brought the total assets up to £153,000. Plaintiff, counsel said, applied for shares on the faith and relying on the truth of the statements in the prospectus, and was allotted 500 preference and 500 ordinary shares. On May 11th the sale of the company by Mr. Atherton was completed, while on the 10th their consulting engineer had advised them to drop two departments for electrical work which had been most prominently placed in the prospectus. The first report showed an adverse balance of £12,802 as the result of 16 months' working. The next balance-sheet for January 31st, 1901, showed an adverse balance of £566 15s. 4d. In April a receiver took possession in the interests of the debenture holders, and in May it was decided to wind the company up. On June 15th the undertaking was sold for £60,000, together with £6,056 for trade creditors. Counsel submitted that if he substantially proved what he had stated plaintiff was entitled to compensation.

Mr. Walter Glynn, the plaintiff, stated that in April, 1899, he received a prospectus of the British Electric Works, Limited. He relied upon the statements in the prospectus, and there was not a word of truth in it. Certainly he or anyone else would not have had anything to do with the company if they had known the statements were not true.

Sir Edward Clarke, for the defendants, asked witness whether he suggested that the gentlemen whose names were mentioned on the prospectus put forward fraudulent statements?

Witness replied that he certainly did. The first paragraph in the prospectus led him to believe that they had acquired a first-class engineering works.

William C. Spence, joint liquidator of the British Electric Works Company, stated that the goodwill had been put at £31,000. As regards the orders carried out by the company, witness said that on April 24th, 1899, there was £663 under the head of cycles, £3,434 under the head of mechanical, and £3,044 under the head of electrical. Of the last amount, £942 19s. 7d. worth of orders were executed up to January last.

At this point the Court adjourned until Friday morning.

At the commencement of the hearing on Friday, William C. Spence, one of the liquidators of the British Electric Works Company, Limited, was examined by Mr. Horridge, for the plaintiff. From February, 1899, to April, 1901, witness said, the trading by the company amounted to £85,000. Of this £28,000 was for cycles, £11,000 for electric work, and £45,000 for other work, including "shell work."

By Sir Edward Clarke: Witness did not know whether shell work was electrical work. Between February, 1899, and May, 1899, the sales were £1,402. From February, 1899, to April, 1901, orders were received for £99,000, which Mr. Hall classified as: Electric work, £15,520; cycle orders, £29,378; other goods, £54,070.

Mr. Gowing, of Messrs. Gowing & Ingram, Birmingham, builders of the Cheston Road works, stated that when tendering for the works, the estimate was endorsed "for the erection of new cycle works," and amounted to about £24,000. £12,000 was owing to him when the building was completed, and he had failed to obtain this.

By Sir Edward Clarke: The total amount of his contract, with extras, came to about £32,000.

By Mr. Asquith: The works were built for nothing but cycle manufacturing.

Benjamin Done, Birmingham, representative of C. W. Burton, Griffiths & Co., London, said that he had supplied Hall & Co., Limited, with 40 Spencer automatic machines for the Cheston Road works. They were all for cycle construction.

By Sir Edward Clarke: The amount expended by the company on machines was between £8,000 and £9,000. The machines were not exclusively cycle machines, but could be used for light engineering work.

Frederick George Kirby, manager to Cooper & Good, engineers, Birmingham, stated that he was manager to R. F. Hall and Co., from May, 1897, to June, 1898. At Sherlock Street they only manufactured cycle parts, and the machinery from the old works was removed to the new works. In 1898 he turned his attention to making other things, such as engineers' screws and electric fittings. The fittings were made as models and they did not do any trade in them.

Owen Claude Knight, electrical engineer, said that he had had charge of the electrical plant from January, 1898, to April, 1899. Some lampholders were sent out, and six arc lamps were sent to a cycle show, but they would not burn, and they were brought back.

Mr. Carpenter, commercial traveller, stated that he had been engaged by Mr. Hall in October, 1899, and remained in the service of the British Electric Works Company until June, 1900. Cycles, cycle parts and electrical goods were the articles he was to obtain orders for. The trade name of the goods was "Stellite," but the electric fittings were unknown under that name. He was not successful with the electric fittings. The prices were: lampholders 6½d. each; switches 13s. per dozen; and roses about 6d. each. He found great delay in turning out orders. Of one order for 5,000 lampholders only a small proportion was delivered.

Norman Mountford, commercial traveller to R. F. Hall, Limited, from August, 1897, said that for the first six months he had nothing but cycle parts to deal with. Before he left he had a lampholder given to him.

Thomas L. Miller, consulting engineer, examined by Mr. Asquith, said that he had visited the Cheston Road works several times and inspected the plant. Nearly 50 per cent. of it was not suitable for manufacturing electric fittings. There was no provision for the manufacture of motors and controllers for tramways, nor was there machinery for producing "roller bearings for reducing friction" as would be believed from the prospectus. The machinery was suitable for turning out large quantities of work, such as cycle accessories. He had examined 58 patents taken over from Mr. Hall; they were patents relating to cycles or their parts. None were connected with electrical work. None of the five electrical patents, since applied for, had been granted when the prospectus was issued. Two of these, an improvement in electrical switches and an improvement in electrical tumbler switches had not been put on the market, as far as witness knew. An improvement in lampholders had been manufactured, and the cost would not exceed 3½d. to produce. Another patent was a combined electrical switch and lampholder, but that type of switch had been condemned by the insurance companies.

In reply to Mr. Pickford, Witness said that the machines at the British Electric Works would make fittings, but not economically.

Benjamin Done, recalled by Sir Edward Clarke, said that he had supplied machines similar to those of Messrs. Hall, Limited, to electrical works. As far as he knew, the machines had given every satisfaction.

Sir Edward Clarke, K.C., stated that he appeared for all of the defendants but Mr. Goffey, who was represented by Mr. Pickford, K.C., and he addressed the jury on behalf of the defendants. After dwelling upon the gravity of the charge, the learned counsel referred to Acts of Parliament bearing on the case. When a prospectus showed, as the prospectus in question did, a report made by a firm of valuers, so far as the statements in that report went, the directors were clear, counsel said, of any responsibility for liability unless it were shown that the person who made the report was not a person who could be reasonably accepted as competent to make it. With regard to the statements the directors made themselves, they had to show that they had reasonable belief in their truth. He (counsel)

and £2,500 in cash for placing the debentures. They were paid

did not admit that there was a single statement in the prospectus that was not a true one. The promoters absolutely believed in the truth of the statements, and were putting their own money into the concern. Counsel proceeded to review the facts of the conversion of Mr. Hall's business into a company, and the evidence which was obtained at the time as to the nature and value of the business, and as to the subscription for the shares of the company when offered to the public. As regards the names on the prospectus, Alderman Lloyd Higginbottom accepted the chairmanship of the company, and as chairman of the Electricity Committee at Manchester, he knew something about electricity. He subscribed for and paid for 500 preference shares and 500 ordinary, or £1,000 worth. Alderman Higginbottom's father-in-law took 100 shares, and his brother-in-law 100 in the company, and counsel believed not one of those shares had been parted with. Mr. Marriner Brigg, chairman of the British Insulated Wire Company, took 500 preference and 500 ordinary shares. Another member of his family took 800 shares, and another member, a lady, 100 shares, so that he and his family had 1,900 shares between them. Mr. Goffey, a retired solicitor, took 2,000 preference shares and 1,000 ordinary shares, while some relatives of his took another 1,000. The directors all believed the prospectus to be true then and true now, and it was because they believed it to be true that they put their money into it. When the company got into difficulties they paid back a large proportion of the fees which they had received.

Mr. Pickford addressed the jury on behalf of Mr. Goffey. He believed, counsel said, at the time, and now, that every statement put before the public in the prospectus was honestly put before them, and was a proper statement that could be justified. He joined the board of the British Electric Works Company, Limited, without any knowledge of the antecedents of the concern beyond the statements of the valuers, and put £3,000 of his own into the company and recommended a member of his family to put £1,000 into it, and had never parted with a single share.

Alfred Charles Gunnaway, architect, London, gave evidence as to the construction of the Stellite Works for R. F. Hall & Co., Limited.

Ernest Bigwood, auctioneer, Birmingham, stated that on the instructions of the directors of R. F. Hall & Co., Limited, he made a valuation of the Stellite Works in February and March, 1898. The freehold and leasehold property he valued at £34,750, and the machinery at £59,610, and put down £642 odd for the unused premises in Sherlock Street. A quantity of the machinery was suitable for manufacturing cycle parts, and other machinery was suitable for engineering work.

The Court adjourned at this stage until Saturday.

On the Court resuming on Saturday, Mr. Jenkinson, stated that for two years, from 1897, he was manager to the National Electric Wiring Company, and that during that time Mr. R. F. Hall occasionally called upon him with regard to electrical orders. Mr. Hall showed him some lampholders, and the orders given by witness to him on behalf of R. F. Hall & Co., Limited, were, he believed, carried out. Mr. Hall showed him an arc lamp, and told witness he was going to make all the accessories for electric lighting work. The order for £3,000 worth of goods on March 8th, 1899, to the British Company was an absolutely genuine order. Witness subsequently joined the firm of Messrs. Hands, Limited, dealing in electrical accessories, and whilst with Messrs. Hands, visited the works in Cheston Street, to see if they were capable of executing large orders. The automatic machines, in his opinion, were suitable for electrical work, and he never saw lampholders turned out so quickly. He placed orders with the company for most of the electrical fittings they were making at the time. Their patent lampholder was a success. There was an increased demand for the goods made by the company, and they were of good workmanship.

Cross-examined by Mr. Asquith, Witness said he was speaking entirely from memory. The books of the National Wiring Company would show the transactions. He had given orders for lampholders. When giving the £3,000 order he knew the new company was a continuation of Mr. Hall's company. He had *carte blanche* as far as orders were concerned. He did not know that the directors had cancelled a large part of that order. He had no interest in keeping the £3,000 from the knowledge of the directors or in placing it with the company. He desired to get the best material and the best price for his employers.

By his Lordship: He placed the order on more favourable terms than he had previously paid for the same class of articles.

Mr. Tremayne, in the service of the Post Office, said that he had visited the works when in Birmingham in 1899. He was impressed by what he saw as regards facilities for producing telephone instruments, and inquired if they could make 10,000 in a reasonable time if an order were placed with them.

A. R. Bennett, manager of the telephone department of the Glasgow Corporation, stated that a trial order for 50 standard telephones was placed with the company, the order to be increased if the instruments were satisfactory. The instruments were not supplied, as the work of the company was suspended.

Archibald Campbell Elliott, Professor of Engineering at University College, Cardiff, said that he had visited the works of the company and seen the machines. He considered that they were suitable for making small electrical appliances, and for small engineering work generally.

Theophilus Bell Hughes, consulting electrical engineer, Birmingham, gave evidence as to visiting the Cheston Street works in 1897 and 1898. He found them very suitable for the production of small electrical work of all kinds. He could not say that it was a cycle factory and nothing else. He considered the company's patents for switches and fittings valuable at the time, as there had been a change from low to high pressure, and the patents met the case.

Messrs. H. J. T. Piercy, consulting engineer, Birmingham; Sebastian Z. de Ferranti, and J. D. F. Andrews, consulting electrical engineer, London, deposed to visiting the works, and to finding them well equipped for engineering works and for the manufacture of electrical fittings.

Sir Edward Clarke suggested that the jury might visit the works, but the jury did not think this necessary.

The Court thereupon adjourned until Monday morning.

On the Court resuming on Monday morning, the foreman stated that the jury had been thinking seriously about the suggestion made by his Lordship that they should view the works at Birmingham, and with his Lordship's permission they would hear the evidence and then decide whether they should go to the works or not.

His Lordship approved.

Robert Frederick Hall, examined by Sir Edward Clarke, stated that in 1890 he established the business of R. F. Hall & Co., which proved to be one of the most successful in Birmingham, having a turnover of more than £20,000 a year, half of which was net profit. He started business in Sherlock Street in 1896, and spent £26,000 in machinery for engineering work, but not more than £2,000 worth of the machinery could be adapted for other work than cycle manufacturing. In April, 1897, he sold his business to R. F. Hall & Co., Limited, for £98,578. Of this, £23,500 was for machinery. He had £30,000 worth of orders in hand, which he sold for £10,000 in cash and £15,000 in preference shares. Only 12 machines in the Cheston Street factory were exclusively suitable for making cycle parts. Over £40,000 was spent in new machinery for the Cheston Street works, and in making the plant suitable for light engineering and electrical work. In 1898 a receiver was appointed. They tried to get in fresh capital, but without success, and under the receiver the business went down. Witness proceeded to relate the circumstances of meeting Mr. Atherton, and of the sale of the works to him for £55,000, the best offer the receiver obtained being one of £45,000. He had nothing to do with the prospectus, except that he approved of it, and still did approve of the statements as regards the practical part of the business. Every one of the statements was true as far as his knowledge went. He considered his patents were still valuable, and believed that at the price paid for the company, and with the sum available for working capital the business would prove a success.

Sir Edward Clarke quoted from reports to show that the turnover of the factory increased from £400 a month in 1897 to £6,000 a month in February, 1901.

Witness, further examined, said that large sums of money were not spent in adapting machines for electrical purposes, as stated by the chairman at the first meeting of the company, and witness told the chairman so. It was not true that arc lamps put up at the show at the Agricultural Hall would not burn.

Cross-examined by Mr. Asquith, Witness said that from 1890 to 1898 he was exclusively engaged in the manufacture of cycles and cycle parts. The prospectus for the company in 1897 contained no reference to any other business than the manufacture of cycle parts. He was to have a salary of £500 a year and a bonus, but he never earned the bonus. He told Mr. Atherton the works were worth £130,000, which was the amount which had been spent on them. Witness was made manager of the new company at a salary of £1,000 a year. He had nothing to do with drawing up the prospectus. He saw the original draft of it and the final draft.

Mr. Asquith: Apart from one or two orders for screws and the making of electrical patterns, of which there was no output, no work had been done by R. F. Hall & Co. but the making of cycle parts?

Witness replied that he should say that was so.

In answer to further questions, Witness admitted that they had not sold telephones to anybody, but that they had had a trial order from Glasgow, though no delivery was made.

Questioned further on the rise in the price of the works from £55,000 to £142,000 without any addition to the property, Witness said he considered the value was there as £130,000 had been sunk in the property. He called the prospectus fair and honest as far as he was concerned.

James Basnett Atherton, director and general manager of the British Insulated Wire Company, Prescot, said that early in 1899 he heard the works at Birmingham were in the market. He had never had any active participation in the cycle industry, and that industry never entered his mind in connection with those works. He was interested in electrical goods, and with that object went to see the works. It was never part of his scheme to purchase them as cycle works. In February, 1899, he bought them for £55,000. When floated the full capital was applied for. Witness got £57,000 cash as purchase money, and £45,000 cash in lieu of shares, as they had all been bought up.

Questioned by Mr. Isaacs, K.C., as to whether from first to last, as far as he was concerned, the statements in the prospectus were made honestly according to the best of his belief and judgment, Witness replied that they were, and that he believed it still. He believed the company would be a success, and believed still that it could have been made a success.

Witness was examined by Mr. Asquith at length with respect to the attempt to raise fresh capital, and the purchase price of the concern. As a matter of fact, he said £52,000 was the amount which came to him. There were disbursements. Messrs. Davidson and Cookson received 1,250 preference and 1,250 ordinary shares

and £2,500 in cash for placing the debentures. They were paid 10 per cent. for placing the debentures.

His Lordship: Then it came to this—the sum of £5,000 was paid for the purpose of getting into the prospectus the words, "The whole of which has been placed."

Witness: That was so.

By Mr. Asquith: He did not see why the existence of such a contract, if known, should have influenced the mind of an intelligent investor.

The Court adjourned at this stage until Tuesday morning.

On Tuesday morning on the resumption of the hearing, Mr. Asquith continued his cross-examination of Mr. J. B. Atherton, with respect to the issue of £50,000 of debentures of the company, and the commission of 10 per cent. paid to Messrs. Davidson and Cookson for undertaking to obtain subscription for the total issue of the debentures; and with respect to the issue of shares.

Witness said the shares were fully subscribed but not over subscribed. He held 27,297 vendors' shares, of which probably 8,000 stood in his own name. He believed the Hall patents to be valuable, and thought it fair and honest to allude to them as such in the prospectus. He would not say that the amount of £142,000 for which he sold the concern was arrived at independently of the valuation.

In reply to Mr. Isaacs, Witness said he fully believed that £130,000 had been spent on the works. He did not consider that he got a pound out of the shareholders of the British Electric Works Company. They got full value for the money paid.

James William Davidson, accountant, and manager to the Liverpool Mortgage Insurance Company, was examined with regard to his firm agreeing to place the whole of the debenture issue.

Jacob Atherton, London agent to the British Insulated Wire Company, of Prescot, said he considered his brother never made a better bargain in his life than when he bought the works of R. F. Hall & Co. for £55,000. If his brother had had sufficient capital, the public would not have got the concern at all.

Lloyd Higginbottom, engineer, of Manchester, said that in March, 1899, he went to Birmingham to see the works and saw electrical goods manufactured which, in his opinion, would compete successfully with foreign made goods. He believed all the statements in the prospectus to be perfectly true and believed so still, but thought a mistake had been made in starting with so little working capital. Questioned as to the manufacture, Witness admitted that switches had been manufactured as samples only.

Asked if a single switch had ever been sold, Witness replied not to his knowledge. He could not say what the old company did. The goodwill of the business did not enter into his calculations.

The hearing was adjourned until Wednesday.

National Electric Supply Company *v.* Foster.

At the Chancery Court of Lancashire on 8th inst. an action brought by the National Electric Supply Company, Limited, against Frank Foster, a Preston ironfounder, to obtain specific performance of agreement for the sale of land to the plaintiff company, was concluded. The plaintiff company had at various times purchased certain lands in Preston, amongst others from the defendant. After expending a considerable sum in buildings, they found that the property was leasehold and not freehold, and that there were certain restrictions of which they were not told by the defendant. In the end the Vice-Chancellor directed an inquiry to be taken to assess what compensation the plaintiffs should receive, and reserved the question of costs.

CORRESPONDENCE.

Central Station Man's Grievance.

I read in your issue of 9th inst. several letters written in answer to "An Enlightened Student." I have not read his letter, but can gather pretty well from the answers to it what the gist of it was.

I should like to say a few things, therefore, on this interesting subject, from the point of view of a marine engineer, as I have been one myself—an assistant engineer in the Royal Navy, and am now taking up electrical engineering as a profession.

I gather that "An Enlightened Student" considers that an ordinary marine engineer is incompetent to keep watch in a central station, while an electrical student is competent. Now, of course, an engineer officer in the navy is a far better man than a marine engineer in the merchant service, so I will take the case of the ordinary engine room artificer in the navy who would very fairly compare with the ordinary merchant service engineer, and what I say of the naval artificer will hold good for the merchant service engineer.

Now the artificer has the following qualifications:—

1. A knowledge of what responsibility is,
2. A strict sense of duty,
3. A knowledge of the control of all other men under him on watch.
4. A thorough knowledge of all the practical part of his profession, from clinkering a fire to packing a water-gauge glass.
5. An instinctive knowledge born of experience to recognise at once when something is going wrong, either with engines or boilers, the ability to find out what it is, and to put it right.

In other words, he is the man for an emergency, who has known what it is to have the safety of men's lives, perhaps a whole ship's life, in his hands.

He is a man who can and has worked for abnormally long hours under most exhausting conditions.

6. Taking all these things into account, he is a "man who can be relied on."

Add to all these qualifications the necessary electrical knowledge, and a better man will not be found for the position anywhere. This is being proved in everyday life, for the percentage of marine engineers holding responsible positions in central stations is not only very large, but increasing.

Against all these points, it would be interesting to hear what "An Enlightened Student" has to urge on his behalf. It may be hard on him, I admit, but he will find as he gets on in life that it is not necessarily the most enlightened man as to theory that is wanted, but the man with practical experience, who can be thoroughly relied on and who is not afraid of work in any form, manual or otherwise. A marine engineer deals with many perils at sea and has great responsibility, and is therefore probably given preference over others.

One little point, apart from this, in Mr. Pritchard's letter causes me not a little amusement, and that is, that a marine engineer gives up his £15 per month for 35s. per week in order to join the ranks of electrical engineers. I would differ over this point. They give up their work afloat simply because they prefer to live on land. Apart from the fact of leaving a wife and family for months or years at a time, the life of a marine engineer at the best of times is one of the greatest hardship. Only those who have tried it can know of the tremendous strain and wear and tear of it, and many would accept less pay for the easier life on shore.

C. J. Greene.

Noticing the somewhat sarcastic remarks published in these columns in last week's issue of this paper, I hasten to say a few words for the "Enlightened Student," as he seems to be taken as an inexperienced youth with no practical experience.

Now, to put *every* student who has left college with honours as being such is a mistake and an injustice which cannot be tolerated.

I know a few good men who have had five years' training in an electrical and general engineering workshop as apprentices (not pupils), and, in conjunction with this, a thorough grind into the theoretical part at some technical school, then two years polishing off at college, therefore quite competent to set a slide valve (which some marine engineers I have met would make a poor job of), do engine repairs, stoke a boiler, or prevent themselves being blown out of a boiler house by the bursting of a gauge glass, with any marine fitter who has had five years' apprenticeship with a technical training and two years' ocean going.

A marine man's ambition, after leaving the shops, is to get away to sea; after one or two trips, his greatest ambition is to get out of it, and therefore, if he is lucky enough to get into central station work, who can blame him?

But I wish to maintain that the student is much the better man for "Shift Engineer's" job than a marine engineer with a second-class ticket.

H. Baker.

Poor student! As was expected by the writer, the majority of the replies to the grievance under discussion elicited the information that the student—or late student—is the most incapable man about the station. The above statement is echoed by many a marine engineer now in cen-

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tral stations, and herein lies my objection to him; it seems a personal one, but leave others to judge.

A characteristic reply is that of "J. D. A.," who if he be not a marine man, must have entirely forgotten his existence as a younger member of the profession. Perhaps, however, he counts himself one of the minority—that is presumption.

It seems because one designates himself a student, he has no mechanical knowledge or training whatever, although many who do so have spent as much as five years in a mechanical or electrical engineering shop.

The marine engineer on arriving in a station is, for, say, the first three months, very glad to glean information from these students and the so-called assistants Mr. Pritchard speaks of, not by acknowledging his ignorance, oh! no, but by concurring on every point. He gets in charge, and you cannot hold him. He dictates electrical matters, sometimes putting forth some wonderful theories, and keeps harping on his mechanical instinct and what they do at sea.

When some of the younger members attain his age, I am sure they will have made better use of their time, and will not be inclined to ridicule the younger members like "J. D. A." does in mentioning what he does about a gauge glass bursting. Where is the marine man when "fireworks" are going on in the switch room? Seeing how steam is, probably. In spite of all attempts to find him, he comes in when things are at normal, and is surprised at the stupidity displayed, and says that the switch room is the most unimportant place.

One correspondent speaks of philanthropic institutions; judging by some of the marine men who continue to get on stations, one would think they were run on those lines. It is certain that the better ones are quite satisfied with their profession, and if wishing to remain ashore seek responsible *mechanical* positions, several instances of which are known to the writer.

One of the Younger Members.

It is very evident that the "marine fitter" charge engineer has been hardly hit by "An Enlightened Student's" letter from the number of *replies* that are published in your last issue; but the main point has not been answered, viz:—Why do these men take 35s. a week when previously in receipt of a much higher salary? It is only obscurely replied to by Mr. Pritchard, when he mentions that they do not take entire charge until they have fully grasped the fundamental principles of electrical details.

That is the reason pure and simple; the mechanical engineer takes a low wage, knowing his incapability, in order to gain the experience that others have to *pay* very heavily for.

One of your correspondents mentions that the B.O.T. classes them as marine engineers, but I am pretty sure that nine-tenths of these who seek charge engineer positions are more under the category of "marine fitter" than marine engineer.

"San Marino" states that the duties of a charge engineer consist of manipulation, &c., of the different plant in a station, but there is another element to be reckoned with, viz., understanding the theory and construction as well as the manipulation, and this is where the student scores. Again, the same gentleman says the duties do not embrace work outside the power station, but a charge engineer should have knowledge of the work outside as well as inside, for if I am not mistaken they all aspire to chief engineership, and then they have full responsibility of the outside as well as inside; it is here again that the marine engineer is at nought. As to the reference to sound electrical knowledge gained at sea—well, we might just as well speak of a plumber who can make a wiped joint as being a sound cable jointer.

No, sir! All the fine experience obtained at sea is without avail to a charge engineer if a serious breakdown takes place; and it is thus that the student who understands the why and wherefore of all the plant under his care is better able to put matters right than the "fitter" man, whether certificated or not.

The whole question resolves itself into one of £ s. d., for a man, no matter how accomplished he may be in all the requirements of a charge engineer, is passed over if he will not accept a salary which is degrading both to himself and the profession.

I would suggest that the Institution of Electrical Engineers or the M.E.A. adopt certain qualifications and standard of pay which all those responsible for the appointments will agree to, and then we shall not have rank outsiders filling the berths of legitimate charge engineers.

F. W. P.

The Purchase of Foreign Machinery.

Although the letters of "Fairplay" and "Pro Patria," of last week, do little more than pour invective upon my presuming to question anything British as the cause of so much foreign machinery being purchased, I cannot allow them to pass without notice.

The letters are fair examples of that unreasonable intolerance exhibited by a section of British public against all unfavourable criticism; their favourite method of reply is mud slinging, the critic is denounced as unpatriotic, "a hater of his country and countrymen," actuated by "malignant spite," due to his "transcendental abilities not being fully recognised," and so on *ad nauseam*.

But the business of buying and selling dynamos is not carried on by any firm I know of for the love of his country, countrymen, or countrywomen, neither is it run for patriotic or philanthropic reasons, and as a consulting engineer, I feel that I would be doing an injustice to my clients if I were to allow my patriotic or any other personal considerations to bias my advice. If my clients desire patriotism and love of their countrymen to be taken into account, they have only to instruct me to confine my choice to British-made machinery. I take my instructions from the man who pays for the machinery. But I have not found an intending buyer ready to restrict the choice to Great Britain.

I have given my opinion based on experience as to the cause of the purchase of foreign machinery. To impute "hate of country," "malignant spite," and the rest of the rampant jargon of the mock patriot, instead of refuting the statements, is contemptible.

A Consulting Engineer.

I should like to answer "A Consulting Engineer's" letter in your paper of July 26th last, under the above heading, at some length, and to add my remarks to those made by "Fairplay" and "Pro Patria" in this week's Journal.

There is a strong feeling in engineering circles generally against consulting engineers as a class, and this because they possess among their members—and, unfortunately, they are not the exception—gentlemen of "A Consulting Engineer's" standing.

No one would think of blaming "A Consulting Engineer" for placing his orders out of this country when it is really necessary, but, like many others who find themselves compelled to do these things, the real reasons are usually better than the apparent reasons, and it is only the apparent reasons which we are supposed to know.

The electrical industry has grown at such a pace that it may seem a rash thing to say, but yet I am convinced, that if I knew "A Consulting Engineer's" name, I would be able to give some better reasons why this gentleman buys his machinery abroad than he has given us.

"A Consulting Engineer" evidently takes exception to the leader in your paper in which it is pointed out that at this present time much can be done by purchasers and their advisers in helping our manufacturers in the way of a little foresight in ordering.

I need scarcely point out that our English shops have been mainly built up with capital privately subscribed, and profits subsequently made, and that they are necessarily smaller than the Continental and American shops, which have been constructed with capital obtained with exceptional facilities.

Although this may not be a strong argument to bring forward in favour of a little foresight in ordering, to those that prefer to order from abroad, it is the situation in which we find ourselves, and a difficult situation it is, when in competition with foreign manufacturers who carry large stocks of finished material,

I would ask, however, whether the present commercial depression in Germany and America is not due to a large extent to over-production, which accounts for these large stocks?

If this is the case, and everything points towards it, I think it folly to argue that our manufacturers are behindhand in not having done likewise, even if they had been able to obtain the capital to do so.

Newer types and sizes of machines which have hitherto not been made in this country in any quantities, will necessarily introduce some delay in manufacture, however large the factory.

German and American makers, however, due to their home demand, which legislation has not crippled, have had occasion to make most of the patterns for which a demand is just arising in this country, and they are consequently in the happier position of being able to execute orders without the initial delays which all new patterns necessarily involve.

Consequently, if all our engineers followed "A Consulting Engineer," and ordered where the quickest delivery could be obtained, it is to be feared that many of the larger sizes of generators, for which there will undoubtedly be a demand, would not be made in this country for some time to come.

For these reasons, I think the following remarks of "A Consulting Engineer" are neither a correct statement of the situation nor yet a reasonable way to look at it:—

"The matter of delivery is entirely in the manufacturer's own hands; it is too much to expect purchasers to treat with any consideration manufacturers who will not in the face of keen competition help themselves."

If we are competing with foreign manufacturers, who are established on solid ground and working on business principles, we should be open to blame if we lagged in any way behind them; but if we are competing with manufacturers whose principles are likely to land them into financial difficulties, and I believe in some cases this is imminent, it would appear to be better to suffer some slight temporary inconvenience by not being able to compete with some of their offers than to attempt to follow them.

There are some who think that all electrical machinery should be carried in stock, at all events up to, say, 250 KW. sizes, and that for sizes above this raw material should be carried in stock ready for assembling.

These gentlemen, however, are inclined to overlook the numerous types for which they are daily calling, and to ignore the amount of capital which a stock of this description would lock up, a percentage of the total yearly turnover which I am inclined to think no other industry would tolerate when taking into consideration the possible profits to be made in the manufacture, and the fact that this stock is at the mercy of an outside body of engineers, whose ideas and fancies are daily changing.

Secondly, the question of design and build of machines. "A Consulting Engineer" argues that although many of our British-made machines are of faultless workmanship and mechanically unsurpassable for durability, their design is bad and causes failures, and he mentions cases where this has come to his knowledge.

"A Consulting Engineer" is very sweeping in his assertions, and says that "in British machines the electro-magnet designs are mostly faulty," but as he does not go into details it is difficult to know what he means.

"A Consulting Engineer" should, however, not overlook the fact that only the larger and better foreign manufacturers are sending any quantity of their manufactures into this country, whilst we see installed here the manufactures not only of our best firms, but also of the smaller and second-rate firms.

I contend that if the productions of our first-class firms be taken, machinery will be obtained which will run as well as and better than any which can be turned out of the shops of America and Germany, and my belief was strengthened after seeing the running and hearing the comments by those in charge of the 1,000-KW. sets at Glasgow, where English-made machines are running against the productions of Germany and America, all made to the same specifications and built about the same time.

In one respect only will our machines not compare favourably with foreign-made machines, and this is in artistic design and in general finish, both of which are immaterial to the running of the machines, though they undoubtedly go some way towards pushing the sales.

If, however, "A Consulting Engineer" is comparing machines made by our firms not of the highest standing, and the advertisements to which he refers in his letter seem to point towards this, I would remind him that the profession to which he has the honour of belonging, is largely responsible for allowing many of these firms to bring themselves into prominence by obtaining contracts from our municipalities at ridiculous prices.

A large proportion of our consulting engineers in this country are either so weak with their committees, or afraid to appear biassed (which means weakness of another description) that they cannot stand out in favour of a tender of some well-established firm.

The tender of the lowest bidder is usually accepted, regardless of quality, and at prices which our first class manufacturers cannot afford to quote.

"A Consulting Engineer" must not judge British manufacturers by these productions, although they find their way into power stations where one might have expected machinery of first-class design only.

In conclusion, the last paragraph of "A Consulting Engineer's" letter is even more puzzling than the rest:—

"No doubt my experience has been that of others, and it will take more than quick delivery and good workmanship to induce me to advise the purchase of machinery made as at present in Britain for heavy engineering work, however much I should like to do so."

Unless "A Consulting Engineer" can give definite reasons for taking up this position, I think we can only assume that it suits his purpose to go abroad, and that he can obtain terms which the majority of our manufacturers do not care to offer.

These reasons account in many cases for the position taken up by some of our engineers, more than the present state of our manufacturing industry, upon which they are morally obliged to lay the blame.

We want no favouritism; we are ready to stand or fall on our merits.

We are a free country, and welcome fair competition from abroad, although we cannot return it. The least that we can expect in return, however, is, that our engineers should treat us fairly, and not take up the biassed position which a "Consulting Engineer" seems to have done.

Let those of our consulting engineers who despise everything British bear one point in mind, and that is, that our manufacturers are at present the slaves to the consulting engineers in this country; if our American and German competitors obtain a strong footing over here they will teach us one useful lesson, and that is, that they can get on without the assistance of, and in spite of, some of our less experienced consulting engineers.

British Manufacturer.

Electric Motor Cars and Tests.

Mr. Rankin Kennedy, in his article appearing in your issue of July 19th, so carefully confined himself to generalities that we feel some diffidence in answering on behalf of the industry.

However, as only one run worthy of the name "long" has been recently made in this country and recorded in the technical press, namely, that of 94¾ miles made by one car and described in the *Automotor Journal* of June last, we take the opportunity afforded by his condemnation of "long runs" to give some data respecting this and subsequent runs.

It is unnecessary to explain why the distance an electric car can run on one charge is as much a criterion of merit as the distance a cruiser can steam without re-coaling.

The run referred to was not "paraded as a wonderful result," but was published as an example of what a modern electric car of good design could do on average country roads and under every-day conditions.

We admit that the car was "in first-class running condition and full charged"; we believe this to be the condition in which a car should always go out. As for the battery being run to its "very last kick," the last six miles

were covered in 20 minutes, the car returning as soon as the voltage reached 1·8 per cell.

The account of the run referred to contained all the necessary data for a calculation of the power expended as follows.

The car contained 50 cells of 250 ampere-hour capacity weighing 22 cwts. including connections and wooden containers, and, complete with passengers, weighed 42 cwt.

The time occupied in running was $7\frac{3}{4}$ hours, hence the average discharge of the cells was a little over 32 amperes, and when we state that the discharge curve of these cells approximates to a straight line between 2·2 and 1·8 volts, it is seen that the average power required was about 3·2 KW. at an average speed of 12 miles per hour, and the average expenditure of energy per ton mile was 127 watt-hours.

A noticeable feature of this run may here be demonstrated. The cells were discharged in $7\frac{3}{4}$ hours, the rate of discharge thus being considerably below the safe limit, which is usually taken at a 5-hour rate, that is to say, the cells were working under the best possible conditions.

The maximum rate of discharge was 50 amperes on Castle Hill, Maidenhead, and this it may be seen does not exceed the safe limit.

Since May 25th the same car has covered 1,907 miles of ordinary country roads. It has visited Great Marlow, Elstree, Barnet, Hatfield, Welwyn, Dorking, and Reigate, and has completed a four days' tour through Horsham, Brighton, Arundel, Portsmouth, Southampton, Salisbury, and Winchester.

The total number of units received by the batteries during this time has been 979·8, giving, at 3d. a unit, a cost of £12 5s., or about $1\frac{1}{2}$d. per car mile.

It is evident from our records that short intermediate charges have been given to keep the cells in good condition; consequently the above figures do not represent a possible minimum, but an average expenditure under severely practical conditions. With regard to cost of up-keep, it may be stated that up to the present no renewals of plates have been necessary, and no loss of capacity has been observed.

As described in the *Automotor Journal* of July, these cells are Leitner pasted plate cells, manufactured many months ago under Mr. Leitner's superintendence.

The only difficulty encountered has been due to the wearing of the tires. Those used have been 90 mm. Michelins, and it is now proposed to use 120 mm. tires instead, experience having shown that these are capable of giving commercial satisfaction with a car of this weight.

With the same accumulators this car starts on August 22nd on a tour to Glasgow to take part in the reliability trials.

In conclusion, we may say that we know no "obstacle to progress," but there is a distinct hindrance to progress in the attitude of those who endeavour rather to exaggerate the limitations of electromobiles than to strengthen their merited claim to the confidence of the public.

The British and Foreign Electrical Vehicle Company, Limited,

W. D. Seton-Brown,
Works Manager.

August 8th, 1901.

Bonding.

In your issue of the Electrical Review for August 2nd, 1901, p. 207, the statement is made by Mr. Albert B. Herrick that "copper is *misplaced* in the bonds, due to the use of a common-sized bond throughout the whole length of the road."

The correct purpose of bonding, in my opinion, is to make the conductivity of a given length of rail, including a bonded joint, equal to that of an equal length of continuous rail. To ensure efficiency it is usual to somewhat exceed this.

A "tapering bond system" is wrong, because what Mr. Herrick really wants is a tapering rail, and the bonds are only a very small percentage of the whole.

In practice the rail, plus return feeders, approaches the theoretical taper.

T. Stevens, E.M.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug. 14th, 1900.		Week ending Aug. 13th, 1901.	
Adelaide	Value £60	Aden. Teleg. cable	Value £15,190
Amsterdam	60	Alexandria. Teleg. mat.	414
Auckland	85	,, Teleg. wire	40
Buenos Ayres	299	Amsterdam	200
Calcutta	67	Bangkok	48
,, Teleg. mat.	8	Bombay	14
Cape Town	138	Brisbane. Teleg. wire	51
Colombo	8	Calcutta	868
Constantinople. Teleg. mat.	45	,, Teleg. wire	117
Durban	273	Cape Town	1,268
,, Teleg. mat.	720	,, Teleg. mat.	375
East London	506	Colombo	48
Fremantle	167	Copenhagen	2,357
Gibraltar	200	,, Teleg. wire	1,482
Hamburg. Teleg. mat.	1,000	Durban	964
Hong Kong	85	East London	10
Launceston	105	Fremantle	370
Malta	100	Gibraltar	19
Ostend	420	Gothenburg.	32
Perth	85	,, Teleph. cable	93
Port Elizabeth	1,450	Hamburg. Teleg. mat.	30
Shanghai	406	Hong Kong	91
Stockholm. Teleg. mat.	306	Launceston.	341
Sydney	1,058	Madras	735
Wellington	359	Malta. Teleg. mat.	500
		Melbourne. Teleg. wire	373
		Ostend	45
		Otago	82
		Penang. Teleg. mat.	63
		Perth	348
		Port Elizabeth	41
		Rio Janeiro. Teleg. mat.	6,734
		Rotterdam. Teleg. wire	63
		Shanghai	14
		Singapore	97
		Stockholm. Teleg. wire	97
		Sydney	2,538
		Tientsin. Teleg. mat.	654
		Wellington	25
		,, Teleg. mat.	596
		Yokohama	229
Total	£8,010	Total	£37,542

Foreign Goods Transhipped.

Calcutta. Elec. goods	Value £35	Antwerp. Elec. apparatus	Value £400
		Ghent. Elec. apparatus	60
		Gothenburg. Elec. apparatus	40
Total	£35	Total	£500

Apprenticeship Case.—At the Liverpool Summer Assizes last week, before Mr. Justice Bucknill and a special jury, the case of Bell *v.* Blakey was heard. Plaintiff, a seedsman, of Wigan, claimed in respect of non-fulfilment of an apprenticeship agreement. His son had been apprenticed to defendants, Messrs. A. B. Blakey & Co., electrical engineers, of Wigan and Southport, for a term of four years to learn the business in all its branches, a premium of £75 being paid. After the boy had been at the Wigan office of the firm for 10 months, Mr. Bell took him away, as it was alleged that his time was occupied in attending to the men or in brushing out the office. Plaintiff therefore claimed rescission of contract or return of the premium paid (£75). His Lordship suggested that the case was one for settlement by the parties, but after consultation, it was found that an arrangement could not be made, and the hearing proceeded. It was contended for the defence that the boy had been taught all that could be expected in the first year of an apprenticeship. The Wigan business had been given up, but defendants had offered to bear the cost of a railway contract for the boy between Wigan and Southport, but Mr. Bell had not agreed to this. The jury found that there had not been untrue representations by defendants with respect to the arrangement made with Mr. Bell, but that the defendants did not teach the boy the business; that he had suffered no damage, but that Mr. Bell had suffered damage to the extent of £55. Judgment was reserved pending a legal argument.

An Argentina Directory.—We have received for review a copy of the fourth edition of John Grant & Son's (Buenos Ayres) directory of residents in the Argentine Republic and Argentine Commercial Guide. The publication is edited by Mr. Ernesto Danvers who has used every endeavour to render it a standard work on Argentina. In a section entitled "Lighting" we find details tabulated of the 29 electric light stations of the country. There are plants of 7,000, 4,000, 3,000 and 2,500 E.H.P. capacity, and a number of others are enumerated down to 20 E.H.P. Electric power is making headway in Buenos Ayres, about 1,500 E.H.P. being supplied. Tramways, railways, commerce, telegraphs and telephones, finance and other matters are dwelt upon at fitting length in separate sections. The directory should be of real service to those interested in Argentina whether for trade or other reasons. The price (in Europe) is 5s., and Mr. J. Samson, of Dashwood House, E.C., is the London Agent.

Annual Outings.—The first annual outing of the staff and employés of the Electricity Department of the Wimbledon U.D.C. was held on August 3rd, a party of 28 proceeding by brake to Windsor. Dinner was served at the White Hart Hotel, and presided over by Mr. F. Barnes Spencer, the Council's Electrical Engineer.

The Manchester staff of the National Telephone Company held their annual picnic on Saturday. The party, including a large number or ladies of the operating department, drove in brakes to Heatley, where cricket and other sports were indulged in. Tea was followed by music and dancing.

artistic design and in general finish, both of which are

battery being run to its very last kick, the last

Bankruptcy Proceedings.—Under the failure of Joseph Taylor, designer and manufacturer of gas and electrical fittings and art smith, trading at 1A, Dyott Street, Shaftesbury Avenue, W.C., as J. Taylor & Co., the first meeting of creditors was held last week at the London Bankruptcy Court before Mr. C. A. Pope, Assistant Receiver. The debtor states that he has been in business since 1878, and for a time he traded in partnership with another person. He ascribes his insolvency to loss on the trading owing to want of capital; to bad debts; and to his household and personal expenses having exceeded profits. The liabilities are returned at £333 15s. 3d., and the assets at £72 0s. 6d. In the absence of any offer the case was left in the hands of the Official Receiver to be wound up in the ordinary course of bankruptcy. The public examination of the debtor is fixed for September 3rd. The principal creditors are as follows:—

UNSECURED.

Turner, James, Birmingham	£150	0	0
McGeoch, W., & Co., Charing Cross Road, W.C. ..	60	0	0
Taylor, E. E., Wolverhampton	63	0	0

PREFERENTIAL.

Rent	12	10	0

The public examination of Charles Alfred Church, manufacturing electrical engineer, trading at 42, 42A and 42B, Hampstead Road, N.W., under the style of Henry Connolly & Co., was held last week at the London Bankruptcy Court before Mr. Registrar Giffard. The accounts filed by the debtor show gross liabilities £12,334 6s. 5d., of which £2,828 12s. 6d. is expected to rank against assets valued at £7,386 0s. 11d., after allowing £192 16s. 3d. for the preferential claims. According to the statements of the debtor and the observations of the Official Receiver, it appears that the debtor in November, 1889, purchased for £8,500 the business of manufacturing electrical engineers and builders' merchants then carried on at No. 42 and No. 42A, Hampstead Road, and No. 120, Kentish Town Road, N.W., and that about a year later he took additional premises, viz., No. 42B, Hampstead Road, and thereafter traded at all the addresses under the style of "Henry Connolly & Co., Limited." He had between £3,000 and £4,000 capital, and raised the balance of the purchase price on the mortgage of house property, to the greater part of which he had succeeded under his father's will. In June, 1898, he entered into an arrangement with another person whereby it was agreed *(inter alia)* (1) that the latter should advance him £2,000 (at 6 per cent. interest) for 15 months, and should have an option to become a partner at the end of a year, (2) that in the event of his doing so he should put a further sum of £3,000 into the business, and acquire a two-fifths share therein, and (3) that he should be employed by the debtor as cashier and office manager for a year at a salary of £300. The partnership was not effected, and in December last the lender, who had made previous applications, finally demanded repayment of the £2,000, but he (the debtor) was unable to repay it, and on January 18th last an agreement was entered into whereunder the lender agreed to take over the business at No. 120, Kentish Town Road, at a valuation against his claim, the amount of which was then agreed at £1,953. Possession of the business was thereupon given to him, but subsequently the price could not be mutually agreed upon, and the matter was referred to arbitration, which resulted in the lender being awarded £535 8s. 6d. (and costs) in addition to the business. The debtor attributes his failure to pressure by the before-mentioned person, who levied execution at his premises, in consequence of which a petition was filed; also to bad debts, and to lock up of the capital in the business. The examination was concluded.

The application of Johnstone, Benjamin & Co., manufacturers of electric wires and cables, Crown Electric Works, 10, Ascham Street, Kentish Town, was again before Mr. Registrar Giffard last week at the London Bankruptcy Court. It will be remembered that the debtors failed last January, with liabilities £7,480 expected to rank, against assets valued at £5,912, and a scheme of arrangement has been entertained by the creditors under which they are to be paid a composition of 10s. in the £ by instalments extending over six months. The debtors a few weeks since lodged an application for the approval of the Court to the scheme, when the hearing was adjourned to enable the full amount of £4,644 required for the composition and costs to be lodged. Mr. E. L. Hough, sen., Official Receiver, now read his report on the case, and commented upon the circumstances under which the debtors transferred their business to a limited company. It was stated that motions had been launched before Mr. Justice Wright with a view to having the transfer set aside, and after some discussion the application was further adjourned to enable the motions to be disposed of before dealing with the scheme of arrangement. Mr. Herbert Reed, K.C., and Mr. Carrington attended for the debtors, and Mr. Montagu represented the trustee.

A receiving order has been made on debtor's own petition against W. R. Beckworth, electrical and general engineer, Herne Hill, S.E., and Brownlow Street, Holborn.

A receiving order has been made at Blackburn, on his own petition, against Thomas Morley, electrical engineer, of Accrington.

Dissolutions and Liquidations.—A meeting of the Electrical Inventions and Manufacturing Company, is to be held at 3, Mount Street, Manchester, on September 12th, to hear an account of the winding up from Mr. C. W. Provis, liquidator.

Messrs. W. J. Cooper and R. M. Power (Cooper & Co., heating and electrical engineers, Bromsgrove Street, Birmingham), have dissolved partnership; Mr. Cooper attends to debts and continues the business.

Catalogues and Lists.—Messrs. Francis & Spilsbury, of Bucklersbury, E.C., have issued (July, 1901) two lists of the electrical machinery manufactured by "Electrotechnische Industrie" (formerly W. Smit & Co.), of Slikkerveer, Holland, for which they are the sole agents for the British Empire. List 1 is a revised price list of direct current multipolar dynamos and motors, and No. 2 gives details and revised prices of direct current four-pole motors of from 2—35 B.H.P.

The Sun Electrical Company, Limited, of Charing Cross Road, send us a copy of their catalogue of the electrical machinery manufactured by the Compagnie Générale Electrique (Nancy) for whom they act as sole agents for the United Kingdom and Colonies. C.C. bi-polar generators and motors, multipolar generators and motors, non-synchronous single-phase and three-phase motors, synchronous three-phase motors and generators, and transformers are shown, and details are set forth mainly in tabulated form.

Messrs. Ward & Goldstone, of Manchester, are circulating a new list of their electrical supplies. A large variety of accessories for electric lighting work are set out, such as switches, roses, holders, brackets, lamps, bell fittings, dynamo brushes, fuse and switch boards, shade fixers, and so on.

The "Engineering Price List" Summer edition for home circulation has just been issued. This is the ninth year of publication. The book furnishes a useful collection of trade sheets which we should think ought to be of service to shippers and exporters of machinery, as well as to foreign buyers. It is bound in thick blue covers and has a sectional thumb index.

The Imperial Electric Supplies, Limited, of Charing Cross Road, W.C., who are just opening a branch office at Fisher's Buildings, Union Street, Bristol, have sent us a few of their lists in an accommodating binding case which is arranged for the addition of new lists as they are published. The articles and materials dealt with in these lists include the Providence car fender, the "Imperial" enclosed hot wire arc lamp, "Imperial" multipolar dynamos and motors, Macallen overhead material for tramways, D. & W. fuses, cut-outs and junction boxes, electric lighting accessories.

Electric Cable Manufacture in Spain.—Operations have now been started at the recently established works at Algorta, near Bilbao, of the Sociedad de Cables Electricos de Algorta. It is intended to manufacture all kinds of electric cables; but for the present attention is devoted to the production of flexible conducting wire from ½ to 2½ mm. in diameter.

Electric Heaters.—A New York exchange states that the Manhattan Railway Company has awarded the contract for equipping the cars on the New York elevated lines with electric heaters to the Consolidated Car Heating Company, of Albany. The contract is said to be the largest order for this type of apparatus ever given. It includes equipment of 18 heaters per car for 1,200 cars.

Preston.—On Wednesday last week about 40 members of the Leeds Society of Engineers, with the President, Mr. G. W. Blackburn, paid a visit to Preston. After luncheon had been taken at the Castle Hotel, the party proceeded to the works of the English Electric Manufacturing Company in Strand Road, where they were received by Mr. Mott, secretary to the company, and afterwards conducted through the works by that gentleman. The party were also conducted through the Electric Carriage Building Works by Mr. Pickin.

Railway Directory.—The Universal Directory of Railway Officials for 1901 has just been issued by the Directory Publishing Company, of Ludgate Circus. As usual it is compiled under the direction of Mr. S. R. Blundstone, editor of the *Railway Engineer*. In previous years we have referred to its convenient arrangement. A new feature in this edition is the inclusion of practically all tramways worked by power in the United Kingdom.

Technical Dictionary Announcement.—Dr. Hubert Jansen, of Berlin, editor-in-chief of the "Technolexicon," sends us certain circulars referring to the trilingual technical dictionary which the "Verein Deutscher Ingenieure" intends to publish. Dr. Jansen intimates that he is in need of collaborators to gratuitously bring him into communication with such scientific and industrial circles as are able to supply the technical expressions and denominations used in the different technical branches; to assist in noting down the technical words and phrases of their specialty, &c. The dictionary (3 volumes) will be called "Technolexicon," and will be in German-English-French, and published by the Society of German Engineers. Dr. Jansen's address is Dorotheenstrasse 49, Berlin (N.W. 7).

Trade with Japan.—The *Electrical World* quotes the following figures compiled by the Treasury Bureau of Statistics, to show the remarkable growth in the exports of the United States to Japan. The imports from the United States have grown from 6,000,000 yen in 1893 to over 60,000,000 yen in 1900, while the United States, which stood sixth in rank in the list of countries from which Japan drew her imports in 1893, is now second in the list, being only exceeded by Great Britain. In 1900 the list stood: From the United Kingdom, 71,638,219 yen; from the United States 62,761,196 yen; China, 29,960,740 yen; Germany, 29,199,695 yen; British India, 23,516,350 yen; Hong Kong, 10,659,855 yen; France, 8,095,819 yen; and Belgium, 1,949,253 yen. In 1893 the United States supplied 7 per cent., Germany 9 per cent., and the United Kingdom 32 per cent. of the total imports into Japan; in 1900 the United States supplied 21 per cent., Germany 10 per cent. and the United Kingdom 25 per cent. The item of machinery has increased from $104,954 in 1893 to not less than $1,061,224 in 1900.

Trade Announcements.—Mr. James Calmon has taken Mr. D. J. D. Morgan, late of the Electrical Trades Supply, Limited, Cornwall Street, Birmingham, into partnership, and the firm will

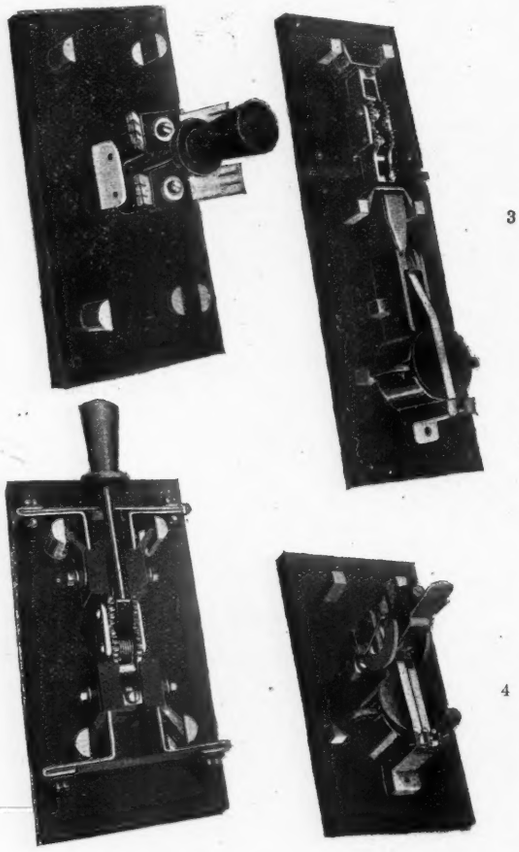
T. Stevens, E.M.

followed by music and dancing.

now be known as Calmon & Morgan, and will carry on business at 23, Temple Row, Birmingham.

We are informed that the businesses of the American Blower Company (London) and of Messrs. Charles Erith & Co. (established 1893), together with the various English and foreign patents of Mr. Charles Erith, have been transferred to Erith's Engineering Company, of 70, Gracechurch Street, E.C. Blowers or fans are now only one of many departments, the other leading specialities being:—Drying apparatus and systems for all materials; heating and ventilating systems for factories, &c.; induced-draft plant (superseding chimneys) for boilers, &c.; Cochrane feed-water heaters and purifiers; Cochrane chemical water-softening system; Cochrane steam and oil separators; Erith's underfeed mechanical stokers; steam engines, pumps, electric motors and engineering plant generally.

Novel Switch Gear.—An interesting and unique series of switches and cut-outs, the invention of Mr. Headley, of St. Austell, is being introduced by Mr. C. R. Heap, of Westminster. The main feature of these is a double-pole double-break switch, of which the two parts are geared together by means of toothed sectors, as shown in our illustration. One of our views shows one of these, provided with a fuse on each pole, in its closed position; another view shows a switch of similar design, but without fuses, in the open position. The arrangement is such that when the switch is closed there is absolutely no tendency for it to open, while it is held in the open position by means of a spring, which also gives a quick break. The two halves of the switch are practically balanced; the pressures between the contacts are also balanced, and it would be easy, if necessary, to remove the interconnecting gear and handle even while the switch was closed and alive. The fixed contacts are so shaped that the pressure of the



1. 75-ampere double-pole switch.
2. Do. do. with fuse.
3. 50-ampere D.P. maximum automatic cut-out.
4. 50-ampere maximum and minimum automatic cut-out.

HEADLEY SWITCHES.

laminated brushes upon their flat faces tends to keep them in their correct relations without steady pins, even if they should become loose; when the switch is off these are the only live parts, and they are highly insulated from one another and widely separated. Special care has been taken to render the construction of the switch as simple and inexpensive as possible. The same principle has been applied to an excess or zero current automatic double-pole cut-out, of the simplest possible type, of which we give an illustration; in this case the spring tends to open both poles quickly, when a catch is released by the action of a small solenoid. Further, by a slight modification, the same switch is made to fulfil the function of *both* maximum and zero current cut-out; such a switch, but single-pole only, is shown in the remaining view. A considerable amount of ingenuity has evidently been expended by Mr. Headley on these clever devices, which form only a selection from a large number of similar apparatus, and we have no doubt but that their utility will be demonstrated by experience.

ELECTRIC LIGHT AND POWER NOTES.

Alfreton.—The D.C. has decided to take no further steps towards the introduction of electric lighting at present.

Ayr.—The tramways permanent way, &c., is now complete, but, on account of non-delivery of cars, the system will not be in working order before at least a fortnight.

Birkdale.—Notice of the transfer of the 1898 electric lighting order from the U.D.C. to the Birkdale District Electric Supply Company for £700 is given in the *London Gazette* for August 13th.

Bognor.—The U.D.C. has decided to light the town with electricity, at a cost of £12,000.

Bradford.—The Electric Supply Committee has again considered the question of increasing the salary of the electrical engineer, which was referred back at the last meeting of the Council, and it has now decided to recommend the Council to grant an increase from £500 to £600 at once, with a further £100 advance in 12 months.

Brazil.—La Compagnie d'Eclairage de Bahia is the title of a company which has just been formed in Brussels, with a capital of £40,000, to carry on the gas and electric lighting undertakings at Bahia, Brazil.

Bury.—After considerable correspondence, Messrs. Fowler & Co. have agreed to a reduction of £500 from their contract price as damages for delay, and in settlement of all questions between them and the Council.

Caversham.—The U.D.C. has had under consideration the desirability of applying for a prov. order to supply the district with electric light, and has had before it an estimate for an initial electric supply scheme based on the assumption that energy was supplied in bulk from the Reading Electric Supply Company at Caversham Bridge, prepared by Mr. A. T. Cooper, manager of the Reading Electric Supply Company.

Cheltenham.—The L.G.B. has consented to the T.C.'s application for powers to borrow £25,000 for electric lighting purposes.

Cleckheaton.—The L.G.B. has sanctioned the borrowing of £24,990 for the U.D.C.'s electric lighting and refuse destructor scheme.

Colchester.—The T.C. has accepted the E.L. Committee's offer to supply current for lighting the public lamps on the south side of High Street at £3 per lantern per annum, each lantern to contain two 8-C.P. lamps.

The L.G.B. has sanctioned the borrowing of £15,825 by the T.C. for electric lighting.

Cowdenbeath.—The contract for the public lighting of the streets has just been let to Messrs. Hunter & Jack, of Glasgow. It consists of 320 16-C.P. incandescent lamps, and the power will be obtained from an engine and dynamo placed near one of the local coal pits.

East and West Molesey.—In view of the need of reorganising the public lighting, the U.D.C. has decided to apply for a prov. electric lighting order.

Eastbourne.—The L.G.B. has given its sanction to the proposed new electric light works, and has given the Corporation authority to borrow for that purpose sums of £43,287 and £7,500, the former for a period of 24 years, and the latter, which is expected to be realised within the next two years by the sale of the present generating station, for two years only. With respect to the proposal to apply the sum of £2,000 which the Council expect to obtain by the sale of old plant in defraying directly the costs of the new works, the Board thinks this undesirable, and suggests that the Council should raise the amount by loan for a short period. This the Council has agreed to do.

Elland.—Mr. W. Emmott, electrical engineer, of Halifax, has been appointed engineer to the Council for the installation of electric lighting plant which they propose to lay down.

France.—The *Board of Trade Journal* notifies that the British Vice-Consul at Kragero reports that there are several large waterfalls about 10 to 12 miles from that town, and a company, with a share capital of about £35,000, has been recently registered for the purpose of working them. The town is to be lighted by electricity, and it is also hoped that factories, workshops, and other establishments driven by electricity will be built in the town and neighbourhood. The company is also building a large dam in order to regulate the river, which brings all the timber from the country down to Kragero.

"As the waterfalls will develop very great power, which will be let out at a low price, and as wages and ground are cheap, it seems

machinery manufactured by "Electrotechnische Industrie"

Cornwall Street, Birmingham, into partnership, and the firm will

probable that money could be invested to good advantage in building factories, &c., in the vicinity of the power stations. It is also probable that this company will supply the power for the contemplated railway."

The British Vice-Consul at Flekkefjord reports to the Foreign Office that electrical works are being built on account of that town. The power (about 1,000 H.P.) is taken from a waterfall situated about 11 kilometres (7 miles) from the town. The light is paid for at a rate of 10s. per 16 normal-candle lamp. For manufacturing use it is paid for at a rate of £2 15s. to £3 18s. per horse-power per year, the rate being cheaper the more the power required. This rate works out much cheaper than the use of steam.

Govan.—The Fairfield Shipbuilding and Engineering Company, Limited, one of the largest shipbuilding yards on the Clyde, approached the Council for the supply of electricity (not less than 300 H.P.) at 1d. per unit for not less than one year or 18 months. At this week's meeting of Council, the clerk was authorised to advise the Fairfield Company that they could have this at the advertised rate, viz., 1½d., and that they were prepared to treat with the company for the supply of current at a special rate, provided the company guaranteed to take a supply for seven years, and, in addition, guarantee an average consumption of not less than eight hours full load per day. It was agreed at the same meeting to get the provisional order amended next session, so as to include the recently annexed wards of South Govan.

Heckmondwike.—The U.D.C. has decided to adopt the "free wiring" principle in connection with its electric lighting scheme. The charges for energy for lighting purposes have been fixed at (*a*) a uniform rate of 5d. per unit, or (*b*) 6d. per unit for the first hour's use per diem of the consumer's maximum demand, and 3d. per unit afterwards, with a minimum charge of 10s. per half-year. Energy for motive power, &c., will be charged at 4d. and 1d. per unit on the maximum demand system. Consumers charged on the (*b*) scale will be required to provide their own meters.

Hong Kong.—The Hong Kong Electric Company held its annual meeting at Hong Kong on July 6th, and paid a dividend of 7 per cent. per annum. The accounts showed available for appropriation $52,831, and of this $23,348 was set down "to write off plant account for depreciation." The company has 13,400 8-C.P. lamps on its incandescent lighting service, and 84 arc lamps. The incandescent lighting plant has been added to by the erection of a steam alternator of improved pattern, to furnish supply during the daytime. This takes the place of one of the older pattern dynamos, and is more suitable for fan supply. New and improved arc lighting dynamos have been put down in place of the original dynamos, which have been in service more than 10 years.

India.—The Government of India have issued their new draft rules for electric lighting and traction on the basis of the English Act, and under the powers they have under Act XIII. of 1887.

Kinning Park.—The Council has agreed to support the Glasgow Corporation in its application for a prov. order for the supply of electricity within the burgh.

Light Railways.—The House of Commons, sitting in committee, has sanctioned the salary of an additional Light Railways Commissioner.

Lincoln.—The Corporation has fixed the rate for electricity for motive power at 2½d. per unit all round, or 4d. and 1d. on the maximum demand system, and will supply motors on hire at a rental of 12½ per cent. on the capital outlay.

Llanwrst.—At last week's meeting of the U.D.C. the tender for street lighting received from the Electric Supply Company was accepted. The terms of the tender were:—The lamps to be lighted with 50-C.P. lights during the season 1901—2 from dusk to midnight; the company to provide all necessary lamps, &c., to be fixed to existing columns for 30s. a lamp.

London.—Stoke Newington.—The B.C. has instructed the Electric Light Committee to obtain a provisional order, in order to carry out the proposed arrangement for the supply of electricity in bulk for the lighting of part of High Street by the Hackney Council.

Woolwich.—The B.C. has adopted a set of Standing Orders relating to tenders and contracts, based on those of the L.C.C. In the electrical trade, for a 54-hours week, the wages are fixed as follows:—Wiremen, 8½d. to 9½d. per hour; jointers, 9d.; labourers, 6½d.; armature winders. 8d.; ditto, helpers or labourers, 6½d.; transformer winders, 8d.; magnet winders, 7d. The rates for overtime are: First two hours, time and a quarter; second two hours, time and a half; after four hours, till starting time next day, double time. These rates apply to all works executed within a radius of 20 miles from Charing Cross; elsewhere recognised trade union rates must be accorded.

Wandsworth.—The B.C. is obtaining professional advice as to the practicability of supplying electricity generated by heat from the Tooting dust destructor.

Hampstead.—The B.C. has resolved that the L.C.C. be asked to advance the following sums on loan to this Council in respect of the estimated capital outlay for electric lighting purposes for the year ending March 31st, 1902:—£13,429 for electric lighting installation, repayable in 42 years, and £6,100 for meters and indicators, repayable in 10 years.

Lowestoft.—The T.C. has received the sanction of the L.G.B. to a loan of £20,000 for electric lighting purposes.

Manchester.—The causes of the proposed advance of ½d. per unit in the price of electricity in Manchester are explained in a report recently issued. It is estimated that at the end of the current year's working (March 31st, 1902) there will be a deficiency on revenue account of £5,014, which sum will have to be taken from the reserve fund. The amount at present in the reserve fund is only £13,172, whereas the provisional order granted by Parliament sanctions setting aside for reserve a sum equal to 10 per cent. on the capital expenditure, which would have allowed the reserve fund at March last to stand at £86,829. In view of the heavy capital expenditure on works and mains, the amount which will be required during next year for interest and sinking fund is estimated at £76,178; this represents an increase of £20,000 on the figure for the current year. The proposal, if adopted, will increase the receipts for the year ending March 31st, 1902, by about £11,000. Instead of building up the reserve fund to the amount allowed by Parliament, large sums, amounting in the aggregate to £52,963, have been paid over to the city fund in aid of rates, and reductions have been made from time to time in the prices charged for energy. For several years past considerable difficulty has been experienced in the endeavour to meet the growing demands of the public for energy: the effect of lowering prices has been to increase the applications for supplies, and at the same time to multiply the difficulties in trying to meet the extra demand. Notwithstanding the fact that the public have known for some months past that it is unlikely the department can supply new consumers with electricity during the present year, the applications now on the books and awaiting connection are equivalent to 52,353 8-C.P. lamps.

Newport.—The borough electrical engineer has reported to the County Council that the total failure of the electric light in the central part of the town for an hour on a recent Saturday night was caused by the fuses of two of the sub-station transformers blowing on account of their being overloaded. Through an oversight on the part of an assistant sent to switch on a third transformer, the high tension fuses were left out, and consequently the transformer was not doing any work.

Normanton.—The U.D.C. has consented to the West Riding Traction and Electrical Supply Company's application to the B. of T. for a prov. order for the supply of electrical energy within the Council's area.

Oldham.—At Manchester Assizes last week an application was renewed by the Attorney-General of the Duchy of Lancaster for an injunction restraining the Oldham Corporation from erecting certain buildings for an electricity station across the site of an ancient footway. They had fenced in the whole of the land, including the site of the footpath, and dug huge trenches with a view to putting foundations in and entirely preventing the public from using that footpath. The defendants agreed to give an undertaking not to build upon the site of the footpath until the trial of the action, with leave to apply for a proper order for stopping up the road. This means that the work of the erection of the much-needed electricity station will be stopped for some time.

Scarborough.—By 10 votes to 9 the T.C. has decided to let a private company construct and work electric trams.

Sheffield.—The City Council on Wednesday was to consider a proposed application to the L.G.B. for their sanction to the borrowing by the Council of the sum of £83,257 10s. 4d. in respect of capital expenditure in connection with the electric light undertaking up to June 30th, 1901, and also the sum of £500,000, the estimated capital expenditure on mains, and in connection with ordinary extensions of the undertaking, up to June 30th, 1902, and in connection with the purchase of land, erection and equipment of the new power station.

Southwold.—The T.C. has received notice from the East Coast Development Company of their intention to apply for a prov. electric lighting order for the borough.

Sowerby Bridge.—The Halifax Corporation offers to supply electricity in bulk to the U.D.C. of Sowerby Bridge at the following charges:—2¾d. per unit up to 15,000 units per annum; 2½d. per unit between 15,000 units and 30,000 units; 2¼d. per unit over 30,000 units per annum.

Mr. W. Emmott, electrical engineer, has inquired of the U.D.C. whether it would be prepared to lease its powers for a number of years, on terms to be mutually arranged.

Swinton and Pendlebury.—The Urban (Manchester) District Council has decided to apply to the B. of T. for an extension of the Council's prov. order for electric power and lighting for a further period of three years.

A sub-committee of the Council has been appointed to deal with a letter from the town clerk of Salford *re* the supply of electricity in bulk to the area of the District Council.

Thornaby.—A special meeting of the Corporation is to take into consideration the expediency of an application to the B. of T. for a provisional order to supply electricity for all purposes within the town.

Woking.—The Council has decided to purchase the electric light company's standards and to disconnect their cables.

Woodbridge.—The U.D.C. has adopted a favourable attitude towards the proposal of the Suffolk Electricity Supply Company, Limited, to obtain a prov. electric lighting order.

ELECTRIC TRACTION NOTES.

Austria.—A public service of electric omnibuses has just been started between Reichenau and Payerbach. The vehicles were built by Messrs. J. Lohner & Co., of Vienna, who are represented in this country by the British and Foreign Electrical Vehicle Company.

Bombay.—A case of some importance is shortly to come before the High Court at Bombay. It appears that Mr. Bingham, who was guaranteed by the Brush Company, of London, obtained a concession from the municipality for electric lighting and traction. The Bombay Tramway Company filed an application against the municipality to contest the validity of their right to sell the tramway to a second party. The first phase of the difficulty came before the Court in July, and the case is fixed for August 26th.

Bristol.—The Bristol Tramway Company have been able to materially improve their service since the account published last week of the dispute with their employés was written. A visitor to the city would notice nothing to suggest that any difficulty had arisen, unless he paid a visit to the temporary camp at the tramway depôt at Brislington, or happened to meet one of the processions still held by the men who have joined the union and ceased to be connected with the service. By Tuesday (when this was written) on some sections of the electric lines the cars were, according to the company's statements, being run with their full frequency, and it was then expected that the service throughout the city would be normal before the week ended. It was found that a few vacancies for drivers remained to be filled, and applicants for these were so numerous that a *queue* had to be formed outside the office in order that the men might be dealt with in an orderly manner. The full staff has now been secured, but the company still have bills out asking for conductors. The men have held daily meetings, and have been accorded a considerable amount of pecuniary support from a large section of the public who disapprove of the company's action in refusing to employ a trade unionist. Funds so received have materially augmented the union's weekly allowance to the men. On the other hand, a large number of the citizens are delighted at the bold and drastic policy so successfully adopted by the company in meeting what they consider a mischievous unionist attack. In the earlier part of the struggle the union men carried notices advising the public to keep off the cars, and similar advice was given in speeches and obeyed by many in working class districts. The announcement was circulated by one of the news agencies that the company had decided to issue writs against those whose who had offended by advocating this boycott, action being based on the recent decision in the Belfast case. The statement went, however, a little beyond the fact, for we believe the company's instructions to their solicitors were to take proceedings, if they considered the circumstances and the law warranted their doing so. What the legal view is remains to be seen.

Cheltenham.—The coroner's inquiry was resumed on 7th inst. at Cheltenham respecting the death of two men who were killed on the 29th ult. by the overturning of an electric trolley car on a trial trip. A considerable amount of evidence was taken, in which it was stated that the car weighed about seven tons without passengers. The car was fitted with both electrical and hand brakes. Previous to the day of the accident the car had been taken successfully up and down the hill, which had a gradient varying from 1 in 21 to 1 in 9½. On the evening of the accident the car had ascended over half of the distance up the hill when it slowed, stopped, and commenced to run back. The brakes were applied, but the wheels skidded on the rails down the hill, and at a curve the car left the rails and overturned, falling on the two men, who were standing on the step of the car, and crushing them to death. It was stated by the attendant at the electrical sub-station that at about the time of the accident the circuit breaker "went" and was immediately replaced, the operation taking about half-a-minute. Mr. Nevins said in 40 years' experience he had never had an accident before. He appreciated the danger, and they were taking steps to provide against it. —The jury considered their verdict privately, and came to the conclusion that the men died from injuries accidentally sustained by the overturning of an electric car which was not under proper control, but they attached no blame to anyone. They considered that in consequence of the steep gradients and curves on Cleeve Hill, the proposed tramcars are too heavy to be used with safety to the public upon the hill portion of the tramway system, and expressed their approval of the steps being taken to add to the brake power used at the time of the accident.

Devonport.—Two electric cars collided in William Street through one of the drivers overrunning the points when going down hill. Several passengers were injured. Some of them jumped over the side of the car when the accident was seen to be inevitable.

Exeter.—The Council, acting on the advice of the Electric Traction Committee, has resolved to appoint an expert to advise generally on the question of electric traction in Exeter and as to route. The Committee has already collected a good deal of information as to the doings of other towns.

France.—The *Standard* says that the recent opening of the electric line from Fayet St. Gervais to Chamounix inaugurates a new era for this famous Alpine resort, and it is probable it will, in a very short time, render Chamounix as popular a tourist centre as Interlaken or Zermatt. The new line passes through some very fine scenery, and crosses the gorge of the Arve by the imposing Viaduct of Ste. Marie, consisting of eight arches, 165 feet above the torrent. It is expected that the line will be continued to Martigny, there joining the great Simplon route to the Italian Lakes and Milan, thus placing Chamounix on one of the great highways between France and Italy.

Glasgow.—In submitting the annual statement at the Corporation meeting last week, the convener of the Tramways Committee, Mr. Paton, stated that they had still £500,000 to expend on new lines, extensions, &c., so that by next year the capital expenditure would amount to £2,300,000. The old horse cars, of which several have been converted to suit the electric system, have so far as they have been sold realised about £80 each. The hours of the men have been reduced still further to 52 per week. Mr. Paton also stated that they were on the look-out for a good guard for the front of the cars to prevent accidents as much as possible.

Four breakdowns occurred during the past week, two being caused by the breaking of the overhead guard wire, one by the breaking of a suspension wire for line wire, and one due to failure in supply of current from one of the sub-stations. Traffic was stopped for 2¼ hours in the aggregate, and much inconvenience experienced. A new route, Bridgeton Cross to Alexandra Park, was opened last Saturday, but as the electrical equipment is not quite finished, horse haulage will be used for the next fortnight. Some 1,600 tons of steel rails have just arrived from America for the extensions of the system.

Govan.—One of the routes traversed by the Glasgow Corporation system, Paisley Road Toll to Linthouse, was successfully started last Monday.

Halifax.—At the last T.C. meeting the Tramways and Electricity Committee presented a return or verification of the expenditure of £14,178 2s. 6d. upon electrical purchases for the 12 months ending December 31st last. Alderman Spencer moved that the return be referred back with a view to an immediate stocktaking. There were no valuations in the return, and he was astonished that there had been no stocktaking. He suggested that some expert from a large company be engaged to do an immediate stocktaking. Alderman M. Booth, chairman of the Committee, said things would be put on a proper footing at the end of the present year, and on this understanding the returns were passed, and Alderman Spencer's amendment rejected.

Johannesburg.—The General Purposes Committee of the Town Council recently reported as follows:—"We recommend that application be forthwith made to the Government for power to erect and work electric tramways for the town and district of Johannesburg." The report was adopted.

Lisbon.—The *Street Railway Journal* states that Mr. W. B. Rommel, chief constructing engineer and general manager of the Lisbon (Portugal) Tramways, is to visit the United States, where he may place some further substantial contracts for equipment, &c. Nearly $1,000,000 has already been placed, directly or indirectly, with American manufacturers for material, &c., for the Lisbon traction system, which will be the first electric road in that part of the world. "The system is controlled by the Portuguese Development Company, of Bishopsgate Street Within, London, E.C., which concern has been largely financed by the well-known financial house of Wernher, Beit & Co."

Liverpool.—At last week's Council meeting, Alderman Petrie stated that at the end of the year the Tramways Committee would probably have a large surplus. The receipts from the tramways up to June 30th last had been £33,000 better than in the corresponding half of 1900. On Bank Holiday the number of passengers carried was 413,308, yielding receipts amounting to £2,034.

An overhead trolley wire in Dale Street broke late on Saturday night and caused some sparking when it fell to the ground. Passengers on an electric car became so affrighted at the occurrence, that a panic ensued, and five of the outside passengers jumped over the guard rail of the car to the roadway. Three of them were more or less severely injured. There seem to have been no serious results save those which were caused by passengers themselves in their excitement.

At the last City Council meeting Ald. Petrie (chairman of the Tramway Committee) stated that the Committee had no intention of again running the German cars and trailers first used on the Dingle route.

Margate.—Last Saturday evening as an electric car was descending the steep incline of Fort Hill it left the rails and dashed into and wrecked the front of a draper's shop. The car was not heavily loaded at the time, but five people were injured, most of them seriously.

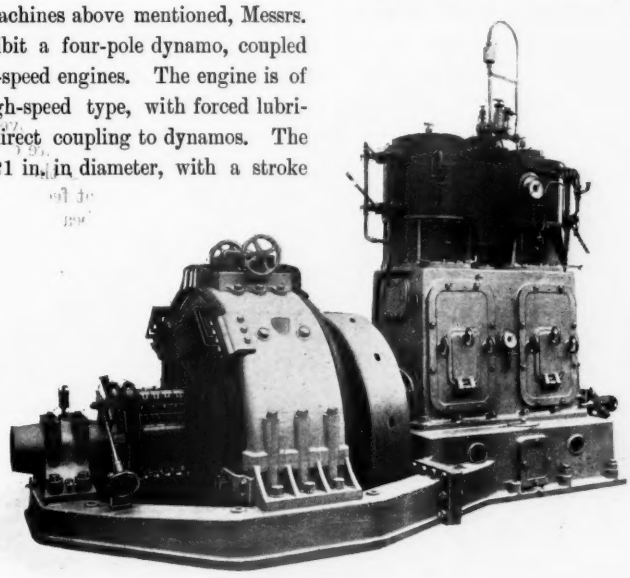
Woolwich.—The M.B.C. has consented to the proposed L.C.C. tramway from the Herbert Hospital to Eltham, as originally proposed, and to contribute one-third of the total cost of the widenings required within the borough, and also to defray the whole cost of widening Well Hall Lane. In view, however, of the "unsatisfactory character" of the L.C.C. widening scheme for High Street, Eltham, and of the "disproportionate benefit to be obtained" from a tramway along it, the Council will not contribute to this portion of the widening, having the further opinion that "there is no urgent necessity for the construction of this line." The County Council's estimates for the Eltham High Street widening are, both sides, £132,000, one side £71,800.

(Continued on page 275.)

GLASGOW INTERNATIONAL EXHIBITION, 1901.

VI.

In addition to the two machines above mentioned, Messrs. Scott & Mountain also exhibit a four-pole dynamo, coupled to one of their own high-speed engines. The engine is of the vertical compound high-speed type, with forced lubrication, specially built for direct coupling to dynamos. The cylinders are 11¼ in. and 21 in. in diameter, with a stroke of 10 in., and the brake horse-power is 240 H.P. at 360 revolutions per minute, with 140 lbs. steam pressure. The steam admission is controlled by a central piston valve distributing steam to both cylinders, the ports being cut in a separate liner of specially close-grained iron, fitted into the cylinder casing. A steam separator is mounted on the engine bedplate.



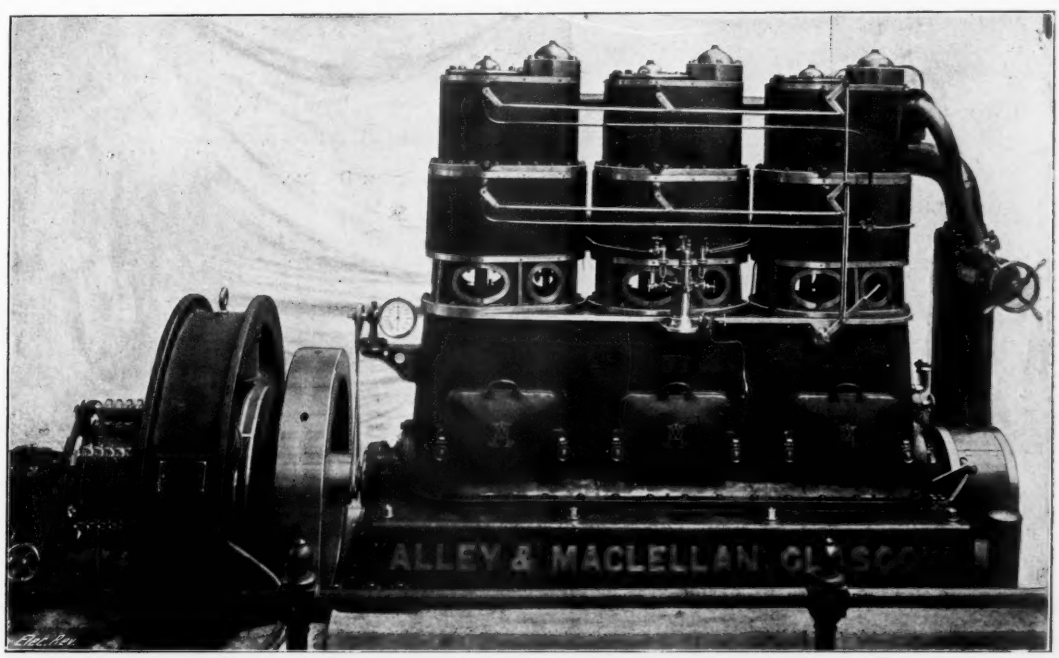
Scott & Mountain 150-kw. Steam Dynamo.

A centrifugal governor fixed on the shaft controls the throttle valve, giving a speed variation guaranteed not to exceed 2½ per cent. between no load and full load. An oil pump worked from the eccentric strap forces oil to all working parts, a separate feeder being taken to the slide. Metallic packing, of Messrs. Scott & Mountain's own make, is used in the stuffing boxes. The cranks are set opposite. A fly-wheel weighing 4 tons is fitted between the halves of the coupling.

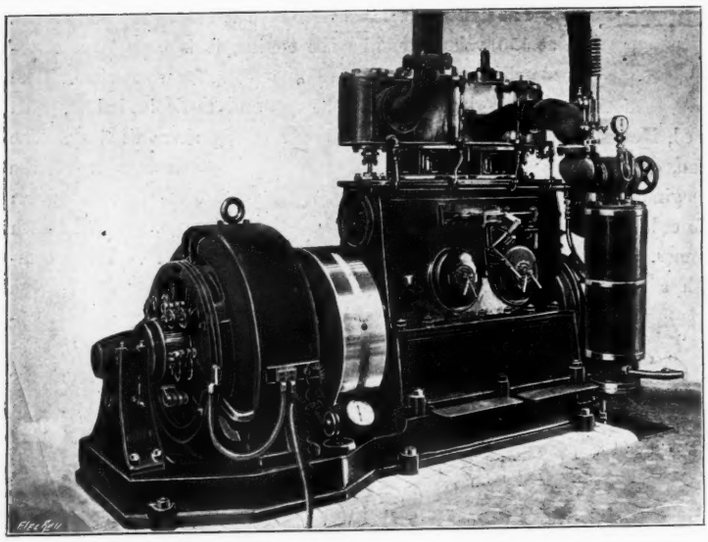
The dynamo is designed to give an output of 273 amperes at 550 volts, but, like the engine, it is capable of withstanding an overload of 25 per cent. for some time. The magnet ring is of circular pattern, made in halves, with shunt winding. The armature is of the slotted core drum type, wound with bars. The commutator is of large diameter; wide copper ed carbon brushes are used, four per set, in patent reaction brush-holders. The pole tips are tapered, and the machine runs without sparking at any load. The outer bearing is of the swivel type, with ring lubrication. The armature spider is bolted direct to the half coupling on the engine crankshaft.

Our illustration shows a combined set of the size and type exhibited, the only difference being the addition of a series winding and regulator.

The joint exhibit of Messrs. Browett, Lindley & Co., Limited, of Patricroft, and the Edison & Swan United Electric Light Company, Limited, consists of a vertical high-speed engine, coupled to a four-pole dynamo. The engine is one of Messrs. Browett, Lindley & Co.'s standard enclosed self-lubricating two-crank compound type; the cylinders are 12½ and 21 in. in diameter, with 9 in. stroke, and the engine is rated at 250 I.H.P at 380 revolutions



Alley & Maclellan High-Speed Engine Driving Mavor & Coulson 180-kw. Dynamo.



Ruston-Proctor Engine Coupled to C. & C. 80-kw. Dynamo.

Messrs. Ruston, Proctor & Co., Limited, show one of their high speed vertical compound double-acting engines, driving a "C. and C." dynamo (C. R. Heap, London).

The cylinders are 9½ and 15 in. diameter × 8 in. stroke, with cranks at right angles, rated at 100 B.H.P. at 450 revolutions per minute. Piston valves are used for both cylinders, the high pressure valve being controlled by an automatic expansion crankshaft governor. Forced lubrication, at a pressure of 15 lbs. per sq. in., is provided to the principal wearing parts, with a sight feed lubricator on the steam pipe. The bearings are lined with anti-friction metal, and the crankshaft is carefully balanced. A separator, fitted with a Sirius steam trap, is provided; the cylinders are not jacketted. The engine bed is mounted on the top of a large base-plate, which carries the dynamo. A heavy fly-wheel is combined with the engine half of the coupling, to which the dynamo half-coupling is bolted.

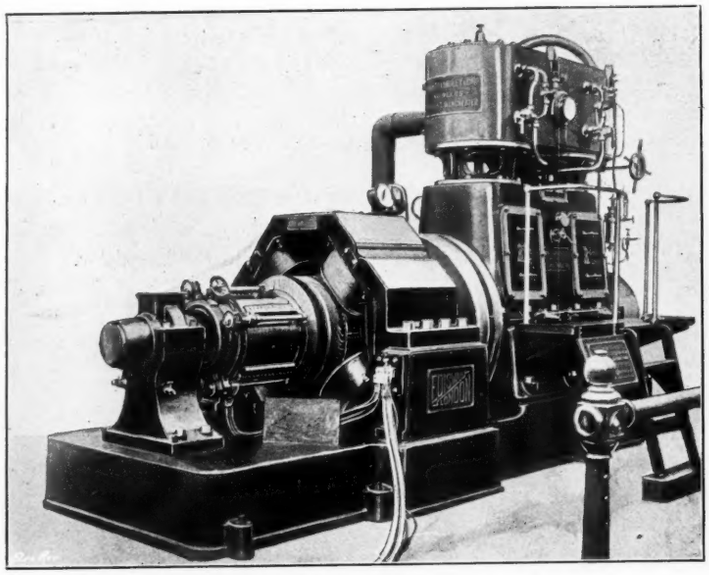
The dynamo is of the multipolar type, compound wound for 250 volts, and having an output of 80 kw. The yoke ring is of cast-steel, circular in shape, and carries a very neat form of brush ring.

The pole-pieces and shoes are cast solid, of the same class of steel as the frame to which they are bolted. They can be removed with their exciting coils, without disturbing the armature.

The armature core is composed of soft steel laminæ, with slotted periphery, drum wound. The carbon brushes are held in a very neat and simple reaction brush-holder.

per minute. The steam distribution is effected by piston valves on both cylinders, actuated by eccentrics; a Browett-Lindley patent inertia governor on the shaft controls the speed by means of the throttle valve, and is adjustable while running. Oil is forced to the working parts by a simple valveless pump driven by an eccentric, at a pressure of 15 to 20 lbs. The cylinders are not jacketted.

The Ediswan dynamo is rated at 130 kw.—500 amperes at 260 volts—with a full-load efficiency of 94 per cent.; half-load efficiency, 91 per cent.



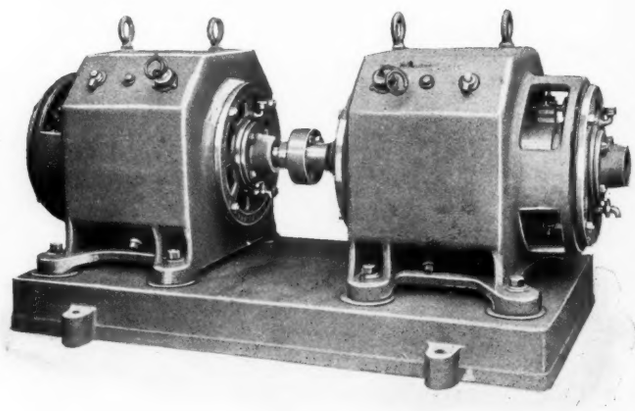
Browett-Lindley and Ediswan 130-kw. Steam Dynamo.

The magnet frame is of special cast-steel, with split pole-pieces, shunt wound. The pole faces are composed of steel plates. The armature is drum wound, with slotted core; the commutator is very long, and is well ventilated. Carbon brushes are used, in small blocks, 13 per set, in constant-pressure brush-holders, arranged so that any brush can easily be removed while running. The outer bearing is fitted with continuous lubrication by means of a disc on the shaft, which dips in an oil bath and carries up a copious supply of oil against a baffle plate.

The parts of the yoke are held together by bolts passing through the pole-pieces inside the magnetising coils, and are magnetically separated by means of non-magnetic metal liners. The machine runs well, without any sparking. The combination is built up on a large bedplate, upon which the engine bed is fixed.

The results of a test are as follows:—

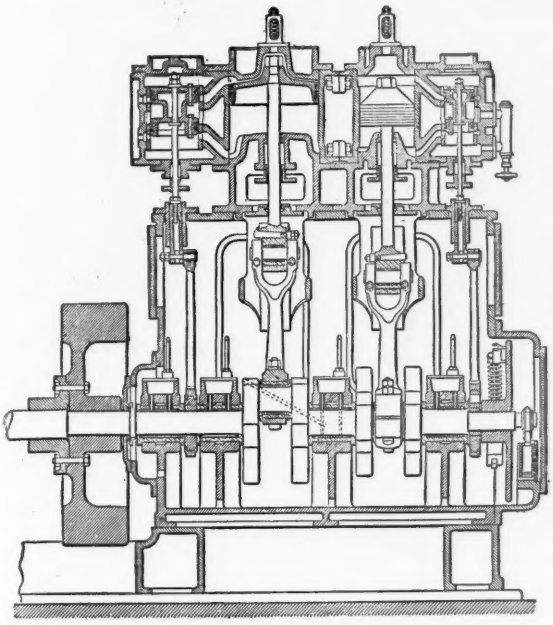
Steam pressure.	Vacuum.	Rev. p.m.	Combined efficiency.	Steam per hour per I.H.P.	Steam per hour per KW.
140 lbs.	26 in.	380	83 %	16·3 lbs.	26·3 lbs.



Bruce Peebles Balancer.

Messrs. Alley & Maclellan exhibit a three-crank treble tandem compound single-acting engine (equivalent to three compound engines), of 300 B.H.P., driving one of Messrs. Mavor & Coulson's dynamos. The engine has three pairs of

cylinders, which are not jacketted, of diameters 11 and 18 in., stroke 9 in., working on a single crankshaft, at 400 revolutions per minute. Splash lubrication is employed, and each steam line is provided with an air-buffer. The steam



Cross-Section of "Ruston" High-Speed Engine.

distribution is effected by three piston valves; a centrifugal governor, working on centres, controls the throttle valve, and can be adjusted by hand while running.

The inspection doors are held in place by a simple clutch, but the supply of water and oil to the crank-chamber can be replenished while the engine is running, without opening the doors. The upper side of the crankshaft is uncovered in the bearings. A single sight feed lubricator feeds all three lines at once. A heavy fly-wheel is interposed between the engine and dynamo.

The dynamo supplied by Messrs. Mavor & Coulson is six-polar, and of very handsome appearance. It is rated at 680 amperes, 250—265 volts. The poles are slightly tapered. The armature has a slotted core, barrel wound, with commutator connections soldered by dipping. The bedplate is not, as usual, in one piece; the field magnet and outer bearing stand on separate cast-iron anchor-plates, built into the foundations. This arrangement is intended to give more ready access to the dynamo, and greater freedom of circulation of air.

Messrs. Bruce Peebles & Co., have installed in the power department a balancer consisting of two similar machines, each capable of giving 100 amperes, 250 volts at 1,000 revolutions per minute, coupled together with a Smith patent coupling. The machines are of the four-pole type, and form a handsome combination. A switchboard, fitted with two centre-zero ammeters, three-pole switches and fuses, a regulator and a starting switch, has also been supplied by Messrs. Bruce Peebles, and stands close by the balancer.

THE TREATMENT OF LUPUS BY ARC LIGHT.

In our issue of July 12th we referred to the improved arc lamp for the treatment of lupus and other skin diseases, invented by Drs. Lortet and Genoud. By the courtesy of Dr. A. Barry Blacker we have been able to take photographs of this lamp in use on one of his patients. It is without question a great step in advance. In its construction the scientific principles on which the bactericidal effect of the light depends have been logically applied in a practical way. The inventors have aimed at avoiding the great absorption of violet, and especially ultra-violet, rays by entirely suppressing the condensers and the water of the original Finsen tubes. They make no attempt to collect the rays from the arc into a parallel beam, but bring the patient quite close up to the arc. Dr. Stebel, of Munich, has made experiments on the comparative penetrating effects of rays of various wave lengths from extreme ultra-violet to blue, through air, blood, gelatine, water, glass, quartz, &c., and has proved that practically all the actinic rays given off by the arc will pass through thin pieces of quartz and about 1 centimetre of water. Drs. Lortet and Genoud have therefore arranged for the arc to be manipulated behind a metal screen or shield, made with two walls, between which water, brought by rubber pipes, flows to cool the metal. Fixed in an orifice in the centre of the shield, so as to be easily removable, is a sort of nozzle, formed by two thin pieces of quartz let into a frame, with a space of about 5 mm. between them filled with flowing water. This quartz nozzle (which is of various sizes and shapes) is pressed on the skin where it is affected by the disease, so as to drive the blood out. The rays from the arc have only to pass through, in order, about 2 centimetres of air, 2 mm. quartz, 5 mm. water, and another 2 mm. quartz before passing into the skin of the patient.

These improvements have resulted in 12 amperes in the

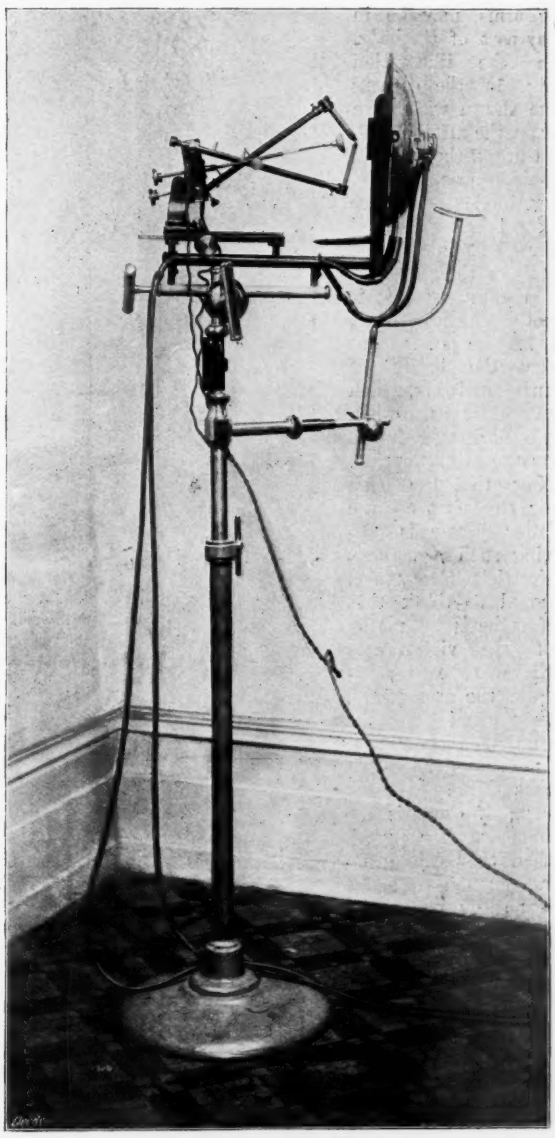


Fig. 1.

Lortet-Genoud lamp, producing the same effect in 20 minutes that the original Finsen lamp, taking 60 to 80 amperes, does in one hour, and a larger patch of skin can also be covered with the light. The great saving both in first cost and

working expense is evident, but what is of more importance is the time saved in treatment. When a patient is afflicted with lupus on many parts of his body and only a small surface of at most 2 sq. in. can be treated at once, a complete cure is the work of many months. It must, however, be pointed out that four or more patients are treated at one time with the original apparatus, whereas the new lamp is only suitable for one case.

The best results are obtained with about 12 amperes and 55 to 65 volts continuous current. With alternating current a sitting double as long is necessary to produce the same inflammation of the skin with the same current.

As regards the arc lamp itself, there is nothing worthy of note, beyond what can be seen from the illustration. It is a hand-focussing lamp, such as is used for cinematograph work, but arranged so that the shield and nozzle can be turned in any required direction so as to suit the position of the disease which, though generally on the face or arms, may be in any part of the body. In the illustration (fig. 1) the carbons are shown withdrawn from the metal shield. In fig. 2 they are in their proper position, but hidden by a piece of coloured glass used for examining the state of the arc.

Fig. 2.

Finally, as this is not a medical paper, it may be pointed out that the bacilli of tuberculosis, which cause lupus, when present in the lungs, cause consumption. Now that the open air treatment of the latter disease is proving such a success, electricians may feel proud to think that if it heals by reason of the violet rays that manage to penetrate the atmosphere, they can improve on sunlight with an arc lamp, or the violet rays from a Tesla coil; if ozone is the influence for good, then they can generate enough to choke a healthy man. All that is wanted is a proper prescription, stating the exact wave length of the rays required to kill the bacilli without doing harm to their environment, or the number of grammes of ozone without any adulteration in the shape of nitrous oxide.

The Lortet-Genoud lamp is being introduced into this country by Mr. Leslie Miller, of 93, Hatton Garden, E.C.

LOCAL AUTHORITIES AND PROVISIONAL ORDERS.

In our comments upon the action of the Local Government Board in authorising a loan for an electricity supply scheme at Tonbridge against the expressed will of the ratepayers, we raised the question whether a provisional order can be legally applied for by a local authority without first obtaining the consent of the ratepayers. It is clear that a local authority cannot promote or oppose a Bill in Parliament without a vote in favour of such procedure, and a single ratepayer at the meeting called for the purpose can demand a poll.

The technical point is, therefore, whether a provisional order is or is not an Act of Parliament, the promotion of which requires the sanction of the owners and ratepayers in the manner provided for by Schedule III. to the Public Health Act, 1875.

Under Clause 4, Sub-section 2, of the Electric Lighting Act, 1882, it states definitely that "*any such order shall be of no force unless and until it is confirmed by Act of Parliament.*" It is clear, therefore, that a provisional order is an Act of Parliament, and the only question is as to whether it can be promoted in a different way from any other Act.

The Board of Trade practically examine all applications of the kind on behalf of Parliament, with power to reject any which appear to them to be undesirable to submit to Parliament; but the confirmation of an order, when granted by the Board of Trade, is not a mere matter of course, as the Bill must pass through all the stages in both Houses, and may be amended or rejected at the will of Lords or Commons.

It might be argued that, as the Bill is promoted by the Board of Trade, the local authority are not technically the promoters, that it is a departmental action of the Government, and does not require any previous sanction of the ratepayers; but this view would ignore the original responsibility of the local authority to secure the consent of their ratepayers before making an application which they know can only be granted with the consent of Parliament, whether that consent is asked for by themselves, or indirectly through the Board of Trade.

As to the duty of the local authorities in this matter there cannot be any doubt. They may think that the mere fact of their being the representatives of the ratepayers entitles them to take any course which they may consider to be conducive to the welfare of the town, but the Legislature has never sanctioned any such principle, or it would not have required the special reference to the ratepayers in the case of additional powers being required from Parliament involving heavy expenditure and exceptional undertakings.

There is no doubt a very general laxity on the part of ratepayers in performing their municipal duties, the govern-

ing body who are to be entrusted with the important duties, upon the wise fulfilment whereof depend the health and convenience of the community, being elected by a small percentage of the inhabitants who grumble when they suffer in person or pocket, but take no trouble when the elections take place to select the most suitable men as their representatives or to instruct them on such questions as speculative municipal trading.

Under such circumstances it is not surprising that town councils do not feel very sensitive about appealing to their constituents except at election times, but on the other hand, the sense of responsibility in making any important new departures should promote a desire to take counsel with those who must "pay the piper" whether or not they "call the tune."

If the law as it exists is not sufficient to protect ratepayers from the unwise action of their representatives, alterations should be made, and there is plenty of scope for an enterprising member of Parliament to deal with the Acts which control the electricity supply industry.

We have dealt with one point only, viz., the right of the ratepayer to have a control over the initial proceedings of the Council in promoting far-reaching speculative undertakings, but there is another aspect of the question equally important, and that is the power given to the local authorities to interfere with private enterprise by allowing them a practical veto.

We have frequently pointed out that it is better for private enterprise to undertake the development of electricity supply —and the principle is gaining ground—but so long as the consent of every local authority having jurisdiction within the proposed area of supply to the grant of the order by the Board of Trade is necessary, the industry will be hampered and obstructed.

It is true that the consent may be dispensed with by the Board of Trade, and in very rare cases they have exercised their power to do so, but, as a rule, the order is refused, and the gas or other interests opposing the grant prevail.

If, instead of the promoters of the order having to obtain this consent, the local authority were only given a *locus standi* to oppose and make out their case, justice would be done, and many abuses prevented.

It is notorious that provisional orders are often taken by municipal bodies for the purpose of obtaining from competing companies different terms from those that the Board of Trade would require if the matter were solely in their hands.

The practice of the department is to prevent all traffic in provisional orders or the exercise of undue influence, but nothing would tend more to realise this ideal than to withdraw the power of refusing consent to applications and to leave the grant in the hands of the Board of Trade.

Another important reform of procedure would be to render it obligatory on the local authority to obtain the consent of the ratepayers previously to a loan being granted; had this been done Tonbridge would not have been plunged into a speculation from which the unwilling town will probably suffer for many years.

ELECTRIC TRACTION NOTES.

(*Continued from page* 270.)

Newcastle.—A sub-committee recommended the New Tramways Committee to appoint Mr. Le Rossignol, who is at present acting as resident engineer for the tramways under Mr. Hopkinson, general manager and electrical engineer, at an additional salary of £250 per annum (making £750). When the committee discussed the matter an amendment was moved that the positions of general manager and electrical engineer be divided, and that there be two heads of departments instead of one. The voting was 9 in favour and 11 against the amendment. Particulars of the arrangements which prevail in other towns are to be collected. The appointments of other officials and staff are standing over meanwhile. At the end of July 22½ miles out of 31 contracted for had been completed. The system will commence running at the end of October or beginning of November.

Rothesay.—The tramway company declared a dividend of 7 per cent. on the past year's work, and state that a start with the electrical equipment will be made on October 1st, 1901.

Sedgley.—The reconstruction of the tramway line from the tramway depôt, Upper Goural, to the Bull Ring, Sedgley, is now practically completed. The length cannot, however, be used until the Board of Trade inspection has taken place, but a hope is expressed that the Board will give its sanction before the completion of the line between the Bull Ring and the Fighting Cocks in order to avoid unnecessary delay.

Sunderland.—The Tramways Committee have decided to extend the electrical system in two directions. They recommend a route eastward towards the Docks, by way of High Street East, and a route northward to Fulwell village. The former is estimated to cost £17,486, of which no less than £10,000 is to be expended on road alteration and paving. The route includes the worst gradient in the town, although not comparable with many in the neighbourhood where electrical trams are running, and there has been a suggestion to alter the levels. The scheme is too much in *embryo* yet, however, to say what course will be adopted. As to the Fulwell route, the Corporation has not yet power to lay it in the manner proposed, and it is suggested that the Corporation obtain a provisional order to make the deviation they wish from the original plans. In the same order it is purposed to seek powers to make a line to Pallion Railway Station, which will be joined to the west-end routes.

Sweden.—A Stockholm correspondent of the *Financial News* writes that the moment is not far distant when electric traction will be introduced on all the Swedish railways. Sweden, as is well known, is by Nature endowed with enormous water-power, and for many years means have been studied for using these falls in a more extensive manner. A prominent Swedish engineer has just submitted a scheme, according to which some 32,000 H.P. would suffice to work all the Swedish railways, the length of which is about 8,000 miles. This engineer suggests the establishment in the country of 12 central stations, with a producing average of 3,000 H.P. The cost would amount to about 40,000,000 Scandinavian crowns, but he thinks the investment would undoubtedly yield a handsome profit. If the project is sanctioned by the State, the works are to be begun at once.

Shallow Subway Railways.—The London Central Subway Railway, to which reference was made in the ELECTRICAL REVIEW for August 9th, was promoted in 1889, and a Bill was presented and fought through a Committee of the House only to be rejected, but the scheme was one that might have been a success. The proposal was to excavate the street from kerb to kerb, or even further, when necessary, put up lines of columns, and throw girders across the street covered by buckled plates and concrete. It was intended to remove all gas and water pipes and electrical and other lines of pipes or wires, and place them in side galleries. The rail level was to be only a few feet below street level, and the station platforms would be reached by descending a short flight of stairs, the station entrances being by ordinary doorways from the footpath, as with the Twopenny Tube. At the station entrances the pipe galleries were to be diverted, so as to pass behind the entrance steps. There was no really good reason brought forward why the line should not be made; no high flights of speed were contemplated, and the construction of the line would already have saved millions in street disturbances. There were to have been stations at Holborn Circus and St. James Street, Piccadilly, also, we believe, at Regent Circus, Museum Street, and High Holborn. The late Samuel Pope, Q.C., who appeared against the Bill, could make no more telling point than that the promoters were "going to make a drum of the street surface" and "stables of Piccadilly," this latter thrust at the proposal to make a short extension past St. James Street and under Piccadilly to house spare cars. The late Mr. Greathead and Sir Fredk. Bramwell both gave evidence against the Bill. The chief opposition came from shopkeepers, who strongly objected to the right of the public to travel without being hauled past and in view of their wares. The cost of construction would not have been excessive, and a mistake was made in throwing out the Bill, for there was absolutely nothing against its successful operation, and looked at to-day, its idea was far and away superior to that of the five-rail system which is known as the mono-rail. We remember the Committee, and were not struck with the amount of grasp they had of the subject. Those who are interested in the opposition as then offered can find it in the books of evidence.

Sir Wm. Preece's letter to the *Times*, which we abstracted last week, has drawn another from Major.-Gen. Webber, in which he says:—"The South Kensington and Paddington Subway Railway—which later, in 1893, developed into the Clapham Junction and Paddington (Tube) Railway—was a 'cut and cover' line similar to that which now traverses Paris. There was no engineering doubt as to the feasibility and economy of that form of construction. It was Lord Kelvin's evidence as to possible interference with scientific instruments used for education in the City and Guilds Institute . . . . . which caused the Bill (in its latest form) to be thrown out. On the other hand, the London County Council, which realised how a railway from Clapham Junction to Paddington would relieve traffic in the more central areas of the metropolis, withheld all opposition except such as was necessary to secure a *status*. . . . The designs and estimates for that subway tramway (as it was more properly called), if they had been carried out, would have provided London with a sample of under-

ground communication that would (with the same capacity) have cost one-third less than will now have to be paid for the lines under the consideration of Parliament."

Following the report of the Joint Committee on London Underground Railways, the House of Lords, on 2nd inst., passed a resolution to the effect that the promoters of 11 Bills mentioned in that report have leave to suspend further proceedings thereon in order to proceed with the Bills, if they should think fit, in the next Session of Parliament, provided that notice of their intention to do so be given within a certain time. It was on 13th officially intimated, says the *Times*, that notice had been given in the Private Bill Office of the House of Lords of intention to proceed with the 11 Bills in question. These measures are as follows:—Brompton and Piccadilly Circus Railway, Central London Railway, Charing Cross, Euston, and Hampstead Railway (No. 1 and No. 2), Charing Cross Hammersmith, and District Electric Railway, City and North-East Suburban Electric Railway, Islington and Euston Railway, King's Road Railway, North-East London Railway, Piccadilly and City Railway, and West and South London Junction Railway.

West Bromwich.—The T.C. last week approved of the purchase of the tramways in the borough on the terms stated in the last issue of the Electrical Review.

Wimbledon. — The U.D.C. having discussed and abandoned two local tramway schemes, has had an interview, in committee, with Mr. J. Clifton Robinson, to discuss preliminaries as to a project for an extension of the L.U.T. system to Wimbledon. The route will probably touch Wimbledon Common, the southern approach to which is a gradient of 1 in 16.

TELEGRAPH AND TELEPHONE NOTES.

Alaskan Cable.—The *Electrical World* says that the party which is to lay the new cable between Juneau and Skagway will leave Seattle, Wash., in a few days. The work will be done by a cable manufacturing concern of New York City. The length of the new line is to be about 126 miles. A steamboat has been chartered and especially fitted up for the purpose, and is now on her way from this city to San Francisco.

Bradford Telephones.—The Finance and General Purposes Committee has appointed a sub-committee to inquire into the establishment of a municipal telephone system for the city.

Cable Communications Committee.—Before this Committee last week evidence was given by Mr. Cuthbert Hall, manager of Marconi's Wireless Telegraph Company.

Eastbourne Telephones.—The National Telephone Company have intimated to the Corporation that they are prepared to sell their local service for such a sum as, if invested at 4½ per cent., would realise the annual net profit derivable from the Exchange area for the year 1900. The General Purposes Committee of the Town Council, who have been conducting the negotiations, recommended the Council to purchase the undertaking on the terms offered by the company except as regards the suggested 4½ per cent. basis. They felt that 5 per cent. should be the basis, but were willing to recommend that 21 years' purchase of the profits for last year should be the basis, subject to the plant and accounts proving satisfactory. The matter came before the Council at their meeting last week. It was pointed out that they were asked to purchase on the basis of some profit in regard to which they could not even exercise their imagination. They did not even know on what principle the profits were to be ascertained. Eventually, the matter was referred back with directions to the Committee to bring up further details.

The Eastern and South Africa Telegraph Company.—In the House of Commons on 9th inst. Sir E. Sassoon asked whether the Chancellor of the Exchequer would state the reasons which necessitated the conclusion of a fresh agreement with the Eastern and South Africa Telegraph Company for a prolonged period, based upon certain stipulations and subsidies, without waiting for the report of the Cable Committee appointed for the special purpose of examining and reporting upon these very terms and conditions; also whether the omission of an expropriation clause on fair terms was intentional. Mr. Austen Chamberlain, in reply, said that the completion of this arrangement had been delayed by protracted negotiations on points of detail, but its principle was accepted by his Majesty's Government and the Cape Government nearly a year before the Cable Committee was appointed.

Glasgow Telephones.—The T.C. has resolved to confer the honour of the freedom of the city on Lord Balfour of Burleigh, the Secretary of State for Scotland, and on Mr. Hanbury, of the Treasury, for their distinguished services to the city. It will be remembered that Mr. Hanbury was at the Post Office when the Glasgow Corporation raised the question of municipalisation of the telephones, and that Lord Balfour of Burleigh was also then secretary at the Scotch office.

Grantham Telephones.—The T.C. has resolved to apply for powers for a £2,000 loan for establishing a local telephone exchange. Major-General Webber advised the committee which has had the matter in hand.

London Telephones.—In the House of Commons on 9th inst. Mr. Heaton asked whether any arrangement had been come to between the Government and the National Telephone Company for equal charges for telephones and telephone services in London; and whether the Government or the Postmaster-General had now abandoned the intention to enter into competition with the National Telephone Company, as indicated in the speech of the late Secretary to the Treasury. In reply, Mr. A. Chamberlain said that negotiations were in progress between the Postmaster-General and the National Company with the view to secure the greatest possible facilities for telephone users in the London district, and, in particular, free inter-communication between all subscribers on either system within the area. As these negotiations were not yet complete, it was not possible to make any further statement then.

Manchester Telephones.—A conference of representatives from the Manchester and Salford Corporations and the neighbouring District Councils was held on 9th inst. at Manchester to discuss a draft scheme prepared by the town clerk of Salford for the creation of a joint telephone board. This scheme has been discussed at previous conferences, but in order to constitute a joint board, an application to Parliament for the necessary powers will have to be made. A working basis has been practically agreed upon, and this is to be laid before the various local authorities, who will send representatives to a conference to be held shortly to consider the whole question.

New Cables.—In connection with the Eastern Extension Company's new cable line to Australia, *viâ* the Cape and Mauritius, the *Daily Chronicle* says that the cable-laying steamer *Anglia* was to leave on Saturday. She has been fitted out by the Telegraph Construction and Maintenance Company, and on arrival at Mauritius will at once proceed to lay the cable to Rodriguez and Cocos, sometimes called Keeling Island. On August 17th the *Scotia* sails for Cocos to lay the section between that island and Fremantle, Western Australia. The new cable line is expected to be open to Fremantle by the end of October, and to Glenelg, in South Australia, in the beginning of next year, but in the meantime Fremantle is, of course, in telegraphic communication with the rest of Australia by land wires. This cable route by the Eastern Extension Company, which approaches Australia in an entirely different way from the others, will make the fourth cable line entering the Commonwealth from Europe. There are already three cables from Banjoewangie, in Java, two going to Port Darwin, in the Northern Territory, and one to Broome, in Western Australia.

The Pacific Cable.—The Pacific Cable Bill was read a second time in the Commons on 12th inst. The Irish Nationalists, of course, opposed for all they were worth. Mr. Henniker Heaton enthusiastically supported the Bill and enlarged upon the great benefits to be derived from cheap cable communication to the Colonies, and the great harm that was being done to trade by the high rates imposed by telegraph monopolists. Mr. Austen Chamberlain, in a very able speech, gave a brief history of the scheme. We extract the following from the *Times* report of the speech:—"The object of the Government had been to secure an all-British cable, and they had attained that object. The Eastern Telegraph Company and its allies had, since this proposal had taken practical shape, and since his Majesty's Government had expressed their willingness to co-operate with the Colonies in laying this cable, offered terms which they never offered before. They had contended, earlier, that the traffic would not bear any reduction of rates, that it did not pay at the present time, and that they could not afford to make the concessions which the Colonies and correspondents in this country desired. It was only when competition had become almost a certainty that the company, whose subsidies had amounted to over a million sterling, offered concessions they had never contemplated before in order to avert that competition. He had been asked whether, in agreeing to help to make this cable, they had taken the precautions they would take if they were dealing with a subsidised company as to Government messages and British employés. Of course, British employés would be employed by the Pacific Cable Board. Not being in the position of men running a purely commercial business, the representatives of the British Colonies and of the British Government did not require to be tied down in the same way as a commercial company would. In the same way, too, as regarded Government messages, it would probably be convenient that they should go at half rates, as they did under most of their cable agreements. But that matter was of much less consequence when the cable was owned by them, for the profits, instead of going to somebody else, as they did when they were dealing with a commercial company, would come back to them. It did not matter so much, therefore, whether they paid full rates or half-rates on Government messages. He had also been asked what payments had already been made. Roughly they amounted to £290,000 due to the contractors, in accordance with the condition named on the contract. This was the first time their great self-governing Colonies had approached this country with a proposal for combined action in a great commercial undertaking. They had done it in the hope of promoting inter-British trade, of increasing inter-British intercourse, and he thought they would have ill responded to the feeling which animated their countrymen if they had not met their advances in a friendly spirit. His Majesty's Government would be loth at any time to refuse altogether to consider proposals of such a nature seriously put forward by their great Colonial Governments. They held that this country had an interest, if not as great as that of the Colonies, at any rate a great interest, in promoting these trade communications

and increasing these cable facilities. They held that the construction of this cable would be of material advantage to them in time of war, and they asked the House to ratify the agreement they had made, and to carry out the undertaking which had already been ratified by every Colonial Government concerned—an undertaking which would form, he hoped, a lasting and successful monument to the co-operation between the Colonies and the mother country. He looked upon it as one of the most fruitful and hopeful schemes that had come before them in recent times, and he warmly recommended it to the House."

The Bill was on the following day discussed in Committee. The Nationalist party again moved amendments, but these were all rejected and the Bill was read a third time.

The Telegraph Wire Export Trade.—The fluctuating character of the export trade of this country in telegraph wire and apparatus connected therewith is well shown by the returns just issued for July. During that month the shipments only attained a value of £53,140 as compared with £245,333 in June last, and £205,306 in July, 1900. So far as the year has gone, however, it has been a good one, the aggregate exports during the seven months ending with July last having attained a value of £1,772,500 as compared with £1,665,016 in the corresponding period of last year, and only £599,308 in the first seven months of 1899.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	.. June 20, 1899 ..	..
Para-Maranham	.. March 1, 1900 ..	..
Cayenne-Pinheiro	.. April 20, 1901 ..	..
Basseterre-Les Saintes	.. June 29, 1901 ..	..
Trinidad-Demerara	.. July 30, 1901 ..	August 6
Anjer-Kalianda	July 30, 1901 ..	August 5
Nase-Keelung (Formosa)	.. Aug. 2, 1901 ..	..
Cadiz-Teneriffe	.. Aug. 6, 1901 ..	..
Landlines :—		
"*Via* Hanekin" on Persian territory ..	.. Feb. 24, 1900 ..	..
Pekin-Kalgan	.. June 14, 1900 ..	..
Maimatchin-Kalgan	.. June 30, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
" " towns of Venezuela	.. Oct. 31, 1900 ..	..

Telegraphs in Arabia.—A considerable extension of the telegraph system in Arabia is about to be taken in hand. A line is about to be erected between Bassora and Nedseh in the interior. A line is also to be established to connect the province of Jemen in the south with the northern line in Hedjas. The latter will start at Lohija, and running along the Red Sea coast connect with the Hedjas system at Lith.

West Africa Cables.—In the House of Commons on Tuesday, Sir Charles Dilke asked whether, in consequence of the recent purchase by the French Government of telegraph cables on the West Coast of Africa, the property of the West Africa Telegraph Company, the lines previously worked by that company would be so deviated as to avoid Bathurst and Accra, with which British possessions these lines were at present in connection. Mr. Chamberlain, in reply, said that the purchase by the French Government of the cables referred to by the right hon. member had not yet been completed, but it has been arranged that the cables which are to be transferred to the French Government will be deviated so as not to touch at Bathurst and Accra. Those places will continue to be telegraphically connected with this country by other lines, which are in British hands.

Wireless Telegraphy.—A system devised by a Mr. Johnson for the transmission of signals between two points, without the risk of their being read by a third party, is on trial at Earl's Court, but is not as yet open to public inspection. The apparatus is in the hands of Mr. J. H. Loch, of the Bouverie Street Electrical Engineering Works, and is said to depend on the syntony of vibrating reeds.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 2nd. Tenders are invited by the Municipality of Amsterdam for the supply of electric cars, 5,000 tons of rails, &c. Director of the Municipal Tramways, Nieuwe Achtergracht, No. 164, Amsterdam.

Aston Manor.—September 4th. Water-tube boilers, 200-KW. and 500-KW. steam dynamos, balancer, switchboard, crane, and arc lamps for the D.C. electricity works. See "Official Notices" August 9th.

Aston Manor.—September 4th. Pipework, fitters' shop and cables for the municipal electricity works. See "Official Notices" to-day.

Belfast.—August 30th. Cast-iron frames and covers, pipes, and bell mouth ends for the municipal electricity department. See "Official Notices" to-day.

Birkenhead.—August 23rd. The Corporation wants tenders for steam engine and dynamo for traction. See "Official Notices" August 9th.

Bournemouth.—August 29th. Boilers, superheaters, economiser, feed pumps, pipework, &c., for the T.C's tramways power station. See "Official Notices" August 9th.

Bournemouth.—August 31st. Tenders for water cooler and travelling crane for the Corporation tramway station. See "Official Notices" to-day.

Croydon.—August 26th. The electric wiring and fitting of the Lunatic Asylum, Warlingham, Surrey. See "Official Notices" August 2nd.

Darlington.—August 22nd. Lancashire boiler, 350 H.P. engine and C.C. dynamo, and steam, &c., piping, for electricity works extensions. See "Official Notices" August 2nd.

Doncaster.—August 17th. The Corporation wants tenders for cables and wires for tramway feeders, also feeder and section pillars. See "Official Notices" August 2nd.

Edinburgh.—September 9th. For the electric lighting installation for the second portion of the Colinton Mains Fever Hospital (800 points), for the Corporation. See "Official Notices" August 9th.

Fulham.—August 28th. The electric lighting of the Fulham Road Workhouse Chapel. See "Official Notices" to-day.

Glamorgan.—August 24th. For the lighting by electricity of Parc Gwyllt Asylum, near Bridgend. See "Official Notices" August 2nd.

Glasgow.—August 30th. The Corporation wants offers for the supply, delivery, and erection, complete, of the overhead trolley constructional work required for the extension of the system. Mr. John Young, general manager, 88, Renfield Street, Glasgow. A Bank Draft for two guineas, with application for specification.

Leigh.—August 24th. A steam dynamo for the electricity works. See "Official Notices" August 9th.

Lowestoft.—September 9th. 500-KW. steam dynamo, switchboard panel, &c., for the municipal electricity works. See "Official Notices" to-day.

Manchester.—August 24th. The Tramways Committee wants tenders for electrical accessories, machine tools, &c. See "Official Notices" to-day.

Mansfield.—September 5th. Refuse destructors for the E.L. Committee. See "Official Notices" August 2nd.

Middlesbrough.—September 3rd. Mechanical coal-handling plant for the electricity works. See "Official Notices" August 2nd.

Newport (Mon.).—September 4th. Telephones, electric bells, &c., for the new workhouse. See "Official Notices" to-day.

Oldham.—September 10th. Two electric travelling cranes for the Greenhill electricity works. See "Official Notices" to-day.

Partick.—12 months' supply of arc lamp carbons, meters, demand indicators, and house fuse boxes for the T.C. See "Official Notices" to-day.

Scarborough.—August 22nd. Tenders for maintaining fire alarms, telephones, bells, &c., for the T.C. Mr. H. W. Smith, borough engineer, Town Hall. Deposit £1 1s.

St. Annes.—August 23rd. A 180-KW. c.c. direct coupled steam dynamo for the Council. See "Official Notices" August 9th.

Walthamstow.—August 30th. Tenders for house wiring for the U.D.C. See "Official Notices" August 9th.

Watford.—August 21st. Wiring the public library and technical school for the U.C. See "Official Notices" August 9th.

Willesden.—The D.C. wants tenders for the equipment of the proposed electricity works. See "Official Notices" August 2nd.

Worcester.—August 23rd. The Corporation wants tenders for water-tube boilers, economiser, pipes and pumps, steam dynamos, motor alternator and booster, Korting condensers, electric pumps, switchboard, crane, and battery for the new electricity works. See "Official Notices" July 26th.

CLOSED.

Alloa.—The contract for the wiring and fitting of the Town Hall and Council chambers has been placed with the National Electric Wiring Company, Limited.

Auckland (N.Z.).—The Auckland Electric Tramways Company has accepted the tender of Messrs. John McLean & Son (£17,433 1s. 8d.) for the work of laying the first line, from the Three Lamps, *viâ* College Hill and Parnell, to Newmarket.

Bradford.—The Corporation has accepted the tender of Veritys, Limited, for a subsidiary switchboard at the Valley Road works, for £270, and the tender of the Phœnix Dynamo Manufacturing Company, for one 20-H.P. motor for hiring, for the sum of £105 with £15 extra for reducing gear.

Cardiff.—The *Contract Journal* gives the following list of the tenders sent in to the Corporation for the supply of about 2,000 tons of steel tramway rails of British manufacture, also for

fishplates, soleplates, tie-bars, bolts and nuts, points and crossings, drain rails, &c.—Bolckow, Vaughan & Co., Middlesbrough*, 45-ft. rails £6 10s. per ton, fishplates £8; Leeds Steelworks, Limited, Leeds, £6 15s. and £8 15s.; Ebbw Vale Company, 122, Cannon Street, London, £7 5s. and £8 5s.; Barrow Hematite Steel Company, Barrow-in-Furness, £7 15s. and £8 15s.; P. and W. Maclellan, 129, Trongate, Glasgow, £7 15s. and £8 15s.; W. Davis, Metal Exchange, Swansea, £8 and £9. * Recommended for acceptance.

Kensington.—The B.C. has accepted Messrs. Crompton and Co.'s tender for the supply of arc lamp columns.

Liverpool.—Mr. Bromley Holmes has submitted a report to the Electric Light and Power Committee, with regard to a proposed generating station at the Charters Street destructor. The committee recommend that the tender of Messrs. Willans and Robinson, to supply four steam dynamos at the price mentioned in their tender, be accepted.

Mexborough.—The Prism Globe Company, Limited, have been awarded the contract for Mexborough arc and incandescent street lighting.

Newcastle.—The City Council has accepted the tender of Messrs. R. C. Brebner & Co. for the construction of the new tramways at Gosforth.

Partick.—Messrs. Kilpatrick & Sons have secured the contract for the wiring of the new Central Station. The contract price for the work is £460.

Portsmouth.—The E.L. Committee has accepted the tender of Messrs. W. Cory & Son, of London, for the supply of "Lambton small" coal, delivered at Portsmouth wharves, at 10s. 5d. per ton, for the ensuing 12 months.

Woolwich.—The M.B.C. has accepted the tender of the Creek Street Engineering Company, at £682, for sinking a well at the Council's electricity works. There were four other tenders, viz., S. F. Baker & Sons, £1,050; Richard D. Batchelor, £1,503 14s. 6d.; Duke & Ockenden, £1,850, and W. Brown & Son, £3,000. The Council has sealed its contract for lighting plant with the British Westinghouse Company.

FORTHCOMING EVENTS.

Tuesday, Wednesday and Thursday, September 3rd, 4th and 5th.—The International Engineering Congress at Glasgow. For details of papers, &c., see Electrical Review "Notes," August 9th.

Wednesday, September 11th to 18th.—Glasgow. Annual Congress of the British Association for the Advancement of Science.

NOTES.

Electric Tramways as Competitors of Steam Railways.—It has been over and over again contended that the operation of up-to-date trolley services, both in and between large centres, would have a rousing effect upon our steam railways and would compel them to adopt electrical working for their branch and suburban sections. That the competition is already beginning to make itself felt is clearly evident from the remarks made by Lord Stalbridge at the meeting of the London and North-Western on Tuesday. In comparing the business of this year with last, he said that there was a tendency to increase the average rate per passenger, which he took to be owing to the loss of short-distance traffic in the neighbourhood of large towns, especially London and Liverpool, through the opening of electric tramways and railways. These new means of communication were growing up all over the country. True, in some cases electric lines acted as feeders for the railways, but in the case of the London and North-Western Company the result had been that the electric undertakings abstracted a considerable quantity of passenger traffic. A somewhat interesting discussion followed his Lordship's speech, and the board was urged to devise some scheme for defending the company against municipal electric traction competition. One shareholder, after stating the fact that the dividend was lower than it had been for 40 years, said it was monstrous that municipalities, with their cheap modes of traffic, should be allowed to filch the traffic from the L. & N. W. Their employés and shareholders, who formed so large a portion of the electorate, should make their influence felt. His Lordship agreed with this view, and proceeded to refer to the Behr mono-rail scheme. Three great companies had built two great lines between Liverpool and Manchester, and then, without a moment's notice (!), a man started up and brought in a scheme to carry people between the two cities in 20 minutes. Everything was being carefully watched, and when it was necessary to build an electric locomotive, Crewe would be perfectly able to do it.

We have naturally a certain amount of sympathy for so well engineered and managed a line as the London & North-Western, but it seems a little too much to demand that street electric traction, which has become the great necessity for all cities, should be hindered because our great railways are afraid of competition.

I.E.E. German Visit.—With a view to giving practical expression to their appreciation of the indefatigable efforts of the popular Secretary and the staff of the Institution in connection with the recent tour, the members of the party subscribed for a testimonial, which was presented on Friday, August 2nd, at 12, Queen Anne's Gate, by Mr. Alexander Siemens, and took the following form :—

A Brooch, with inscription, to Mrs. McMillan.
A Silver Card Case, with inscription, and containing a cheque for £100, to Mr. McMillan.
A Cheque for £50 to the staff.

Notice of the presentation was sent to the contributors resident in London, and a fair number were present. A letter was addressed to the subscribers by Mr. McMillan on behalf of Mrs. McMillan, himself and staff, expressing their cordial appreciation of the sentiments which prompted the presentation, and their hearty thanks therefor. Only those who know the amount of work and worry entailed by the organisation and accomplishment of such an undertaking as the German and Swiss visits, can fully realise how thoroughly the presentation was merited: and we tender our congratulations to the recipients on this appropriate recognition of their labours.

Wireless Telephony.—On p. 594 of our last volume there was given a brief account of Dr. Simon's method of transmitting speech along a beam of light; in this arrangement, a selenium cell in circuit with a telephone receiver was placed in the path of the beam of a searchlight projector, the arc of which was utilised as a transmitter. It is interesting to note that in our issue of September 20th, 1884, p. 231, the suggestion was put forward by "Musicus" (*i.e.*, T. E. Gatehouse) that by means of an incandescent lamp in circuit with a battery and microphone, a pulsating beam of light could be obtained, which, falling upon a selenium cell in circuit with a battery and receiver, would reproduce in the latter the original sounds communicated to the transmitter. We are not aware that this arrangement was ever tried in practice, nor do we think that the same successful result would be obtained with it as with the arc; but the principle is the same. Truly there is nothing new under the sun!

Appointments Vacant.—The Partick T.C. wants an assistant electrical engineer at £104 per annum. Engineering assistants, and a chief draughtsman are required for the Glasgow Corporation telephone department. A foreman cable jointer is wanted for Battersea, a mains superintendent for Maidstone, and an electrician for Colwyn Bay.

An Alarming Experience.—We cull the following thrilling episode from a provincial newspaper :—"According to an official police report, Sergt. Pigg and P.C. Leadbitter had an unwelcome experience during the storm. The telephone wires on the roof of the Monkwearmouth Police Station attracted the lightning, which ran to the charge office. It came out of the telephone instrument and then burst. The fluid then went up the chimney and thus escaped from the building. Beyond scaring the two officers it did no damage."

Award for Finsen.—One of the two scientific prizes of the Nobel Institute, each of 200,000 Danish kroner, equivalent to upwards of £11,000 sterling, is stated by a *Daily Telegraph* dispatch from Copenhagen, to have been awarded to Prof. Finsen, the founder of the Medical Light Institute and originator of the light treatment of lupus.

Personal.—The Swansea Corporation has appointed Mr. Carl Prussmann, borough electrical engineer at Doncaster, to a similar position at Swansea. There were 60 applicants.

Mr. Arthur J. Wheatley, who was for some years chief engineer and manager of the Woking Electric Supply Company, Limited, and latterly on the staff of Mr. Edward Dodd, consulting engineer, Birmingham, has accepted an appointment under the War Office to work out the details of a complete installation for the electric lighting of the Royal Victoria Hospital, Netley, near Southampton. We understand that Mr. Wheatley has previously carried out a similar scheme at Inkerman Barracks, near Woking.

Mr. C. E. Hume, mains superintendent at Bristol, has been appointed resident engineer at Twickenham lighting station.

Our Sunderland correspondent says that "Mr. William Morrison, the manager of the Sunderland electrical tramways, has resigned his position, and his resignation has been accepted by the Tramways Committee of the Corporation, but will have to come before the whole Council. Mr. Morrison has had a lengthy experience of tram work, having been in Sunderland many years, and having managed the tramways under the original company before the advent of electrical traction. There has been no public explanation why he has taken the step, but it is an open secret that it is due to an interference by certain members of the Committee which the manager thinks unjustifiable."

Mr. R. S. Robertson, late first assistant at the City Road station of the County of London and Brush Provincial Electric Lighting Company, Limited, has been appointed resident engineer of the Godalming Electric Lighting Company.

The Blackpool Electric Lighting and Tramways Committee have arranged with Mr. R. C. Quin, the borough electrical engineer, to withdraw his resignation. For some time Mr. Quin has had two days a month allowed him for outside consultative work, but under the new arrangement he will have more liberty in this respect—four days per month up to the end of March, and afterwards seven days.

Glynn v. Atherton.—This case, which is reported at some length in our "Legal" columns this week, was concluded yesterday afternoon. From a telegram to hand just as we go to press, we learn that the decision was as follows :—

Questions put to the Jury.	Jury's Answers.
1. Was prospectus in its general tenor untruthful? Was prospectus false and fraudulent on the part of any and which of defendants?	Yes. Yes, all.
2. Were any of statements of prospectus complained of untrue?	Yes.
3. If so, was the plaintiff induced to apply for shares by such statements?	Yes.
4. Had defendants or any of them reasonable grounds to believe such statements were true?	No.
5. Did they so believe up to the time of allotment?	No.
6. What loss or damage did plaintiff sustain by reason of such untrue statements?	£950.
7. Did defendant or any of them make the untrue statements fraudulently?	Yes. J. B. & J. Atherton did.
8. Were the contracts in par. 6 such as not to disclose what was material to disclose to intending applicants for shares?	Yes.

International Association for the Advancement of Science, Arts, and Education.—The second annual international meeting of this Association, which continues until September 27th, 1901, is being held at Glasgow. It has been arranged that none of its lectures shall be delivered during the Congress of the B.A. The proceedings are being conducted within the University of Glasgow and in the Glasgow International Exhibition, and the arrangements will be essentially similar to those of the assembly held last year under the auspices of the Paris Exposition and of the University of Paris. The Association claims to provide an additional link and means of interchange among scientific and educational workers and movements in different countries. It endeavours to advance the international co-operation of universities and other institutions of higher education, and to co-operate with scientific congresses, associations, and societies, whether special or general, international, national, or local. Furthermore, it seeks to promote the formation and development of scientific and educational institutes, museums, &c., such as those outlined at the close of the Exposition of 1900. For these purposes, at Glasgow as well as at Paris, the Association will again endeavour to avail itself of the accumulated results of industrial effort, of scientific and industrial achievement which make up an International Exhibition. The lectures, &c., arranged for in Section A are as follows:—

Applied Physics.—The opening course will be that of M. Alphonse Berget, D.Sc., Lecturer on Terrestrial Physics, Research Laboratory, Paris. His lectures will deal with general movements of the atmosphere, application of physics to locomotion, automobiles, wireless telegraphy and colour photography.

Teaching of Physical Science.—M. H. C. Benard, D.Sc., Paris, Fellow of the Institut Thiers, will deal with present ideas on the constitution of matter—molecules, atoms, ions, electrons; modern apparatus of precision; physical laboratories, &c., in France, and with the progress of stellar astronomy since Herschel.

These preceding lectures are to be delivered in French on Tuesdays, Thursdays, and Saturdays.

Lectures in English on physical science, pure and applied, will also be delivered; thus Prof. Walker will lecture on "Modern Theories of Solution;" and Prof. Kuenen on "Recent Electrical Theories."

In electricity Prof. Baily and other electricians will lecture on the history of electricity, on electrical measurements, on illuminants, on the heating and chemical action of electricity, &c. Appropriate visits will be arranged.

NEW COMPANIES REGISTERED.

Power-Gas Corporation, Limited (70,860).—This company was registered on July 16th, with a capital of £350,000 in £1 shares (100,000 deferred), to acquire any patents and rights relating to the production of fuel, gas, sulphate of ammonia and other bye products, to adopt agreements (1) with Dr. L. Mond, and (2) with E. J. Duff and the United Alkali Company, Limited, to manufacture, produce and recover from coal, slack, dross, town and other refuse and fuel of all kinds gas, ammonia, sulphate of ammonia and other bye-products, to sell and supply the same, and to carry on the business of chemical manufacturers, electricians, mechanical engineers, suppliers of electricity and gas for light, heat and power, manufacturers of coke, briquettes, coal tar, pitch and asphaltum, &c. The first subscribers (each with one ordinary share) are:—H. W. Brown, 63, Mackenzie Road, Beckenham, clerk; J. A. Fuller, 50, Chatterton Road, N., clerk; E. S. Harper, 76, Oliphant Street, Queen's Park, W., clerk; A. J. W. Lawson, 43, Forest Drive West, Leytonstone, secretary; P. M. Cullen, 37, Seymour Road, Hornsey, N. gentleman; F. H. Riches, Alberstoke, 44, Shenley Road, S.E., clerk; and E. T. Church, 2, Kepler Road, S.W., clerk. Minimum cash subscription, 75,000 shares. The number of directors is not to be less than five nor more than 15; first are to be appointed by the subscribers, subject to the rights of Brunner, Mond & Co., Limited, Dr. L. Mond, the United Alkali Company, Limited, and E. J. Duff to nominate one director each so long as they each hold 2,000 shares (provided that Dr. L. Mond and E. J. Duff may not exercise such right while they are themselves directors); qualification, £500; remuneration, £3,500 per annum and a share in the profits divisible.

Ferranti, Limited (70,868).—This company was registered on July 17th, with a capital of £400,000 in £1 shares (200,000 6 per cent. cumulative preference), to acquire, continue, and extend the business formerly carried on as a private company by S. Z. de Ferranti, Limited, at Hollinwood, Lancs., to acquire any other electrical, mechanical or general engineering businesses or any patents relating to electricity, and to carry on the business of electrical, manufacturing and general engineers, contractors for the erection of central stations for the supply of electricity for motive and other purposes, and workers of such stations, constructors of railways, tramway and waterways, brick, cement and concrete manufacturers, stone quarriers, &c. The first subscribers are:—S. Z. de Ferranti, Lyndhurst Road, Hampstead, engineer, 1,000 shares; A. B. Anderson, 75, Promenade, Southport, accountant, 1,000 shares; C. Day, Grove House, New Moston, engineer, 1,000 shares; G. del Rivo, Boscombe, Liverpool Road, Birkdale, engineer, 1,000 shares; A. E. Hadley, 15, Belgrave Crescent, Eccles, engineer, 1,000 shares; W. D. Davidson, 40, Parkfield Road, New Moston, Manchester, secretary to S. Z. de Ferranti, Limited, 1 share; and H. V. Ash-

worth, 33, Belgrave Road, New Moston, Manchester, chief clerk to S. Z. de Ferranti, Limited, 1 share. Minimum cash subscription, £60,000. The number of directors is not to be less than two nor more than five; the first are S. Z. de Ferranti, A. B. Anderson, C. Day, G. del Rivo, and A. E. Hadley; qualification, £1,000; remuneration as fixed by the company. Registered office, Hollinwood, Lancs.

Traction and Power Securities, Limited (70,991).—This company was registered on July 27th, with a capital of £1,000,000 in £10 shares, to acquire and hold shares, stocks, debentures, debenture stock, bonds, obligations, warrants, certificates of indebtedness and securities issued or guaranteed by any company constituted or carrying on business in the United Kingdom, or any Colony, dependency or possession thereof, or in any foreign country, or by any Government, sovereign ruler, commissioners, public bodies or authorities, to deal with and turn to account any securities, and to carry on the business of bankers, capitalists, financiers, concessionnaires and merchants, and any financial, commercial, trading and other operations and businesses except the issuing of policies of assurance on human life. The first subscribers (each with one share) are:—L. H. Grundy, 9, Southwood Mansions, Highgate, solicitor; J. W. Paget, 48, Arbour Square, Stepney, E., shorthand writer; J. W. Ward, 14, Marney Road, Clapham Common, S.E., gentleman; J. F. Cooke, 45, Rymer Road, Addiscombe, clerk; W. H. Fay, 21, Seymour Place, S.W., shorthand writer; F. C. Booker, 47, Princess Road, Oxford Road, Kilburn, N.W., clerk; and M. Dewey, Carisbrooke, Finsbury Park, N., solicitor. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are George Westinghouse, Joseph H. Lukach and Constantine W. Benson; qualification, £100; remuneration, £1,500 per annum, divisible. Registered office, Westinghouse Building, 2, Norfolk Street, W.C.

Witting Bros., Electrical Engineers, Limited (71,038).—This company was registered on August 1st, with a capital of £40,000 in £20 shares, to adopt an agreement with Witting Bros., Limited, to carry on the business of electrical and general engineers, contractors and manufacturers of and dealers in electrical and other machinery and articles to or in relation to which electrical power or electrical process of any kind may be applied or used, and to acquire and turn to account any patents, inventions and the like. The first subscribers (each with one share) are:—S. C. Witting, Hollingbury Copse, Patcham, Sussex, merchant; L. Wiese, 4, Whitehall Court, S.W., merchant; G. H. Cornelsen, 16, Rue St. Marc, Paris, merchant (by his attorney, S. C. Witting); A. C. Eborall, 4, Aynhoe Mansions, Brook Green, W., engineer (by his attorney, S. C. Witting); H. R. Witting, 19, Mill Hill Road, Acton, W., clerk; E. E. Tasker, 3, Cumberland Terrace, Lloyd Square, W.C., engineer; and T. R. D. Kenny, 13, Marnock Road, Crofton Park, London. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are S. C. Witting, F. Charles and L. Wiese; qualification, 50 shares.

Liverpool Electric Cable Company, Limited (71,099).—This company was registered on August 10th, with a capital of £10,000 in £1 shares, to adopt and carry into effect an agreement with Robert Taylor, and to carry on the business of manufacturers of and dealers in wires, cables, and lines of all kinds, electricians and manufacturers of and dealers in apparatus and things required for or capable of being used in connection with the generation, distribution, supply, accumulation and employment of electricity. The first subscribers (each with one share) are:—J. M. Wood, 21, Water Street, Liverpool, merchant; R. Taylor, 789, Chester Road, Stretford, near Manchester, electrical engineer; H. G. Tippet, 292, Vauxhall Road, Liverpool, rubber manufacturer; C. S. Watson, 5, Chapel Street, Liverpool, merchant; S. Harrison Follin, 90, Burleigh Road, Liverpool, gentleman; P. Lace, 19, Parkfield Drive, Liscard, manager; and C. Collins, 34, Castle Street, Liverpool, solicitor. No initial public issue. The number of directors is not to be less than three nor more than five; the first are G. Jaeger, J. M. Wood, and R. Taylor; qualification, £200; remuneration as fixed by the company. Registered office, 292, Vauxhall Road, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Metropolitan Electric Supply Company, Limited (25,395).—This company's annual return was filed on April 11th, when 98,775 shares were taken up out of a nominal capital of £1,000,000 in 100,000 shares of £10 each. £10 has been called up on each of 82,968, and £7 10s. on each of 13,775 shares, resulting in the receipt of £932,992 10s. £20,320 considered as paid on 2,032 shares. Mortgages and charges, £470,000.

Oldham, Ashton and Hyde Electric Tramway, Limited (55,318).—This company's annual return was filed on May 3rd, when 4,000 ordinary and 4,000 preference shares were taken up out of a nominal capital of £100,000 in 5,000 ordinary, and 5,000 preference shares of £10 each. £10 has been called up on each share, resulting in the receipt of £80,000. Mortgages and charges—£40,000.

CITY NOTES.

Waterloo and City Railway Company.

Lieut.-Col. Campbell presided on 8th inst. over the fifteenth half-yearly meeting of the above company held at Waterloo Station, and, in moving the adoption of the report, said the authorised capital was £720,000, and of that £599,000 had been created, namely, £540,000 ordinary stock and £59,000 debenture stock. £599,184 had been expended on capital, including £4,392 during the past half-year, £732 had been spent on electric pumps, and £3,657 had been paid to the contractors for the electrical equipment. The total expenditure to the present time was well within the original capital powers, and they still had £112,482 available to meet any future expenditure. In account No. 7 they put down £15,000 for future expenditure, but that was a mere estimate, and they did not know at the present time whether they might be called upon for anything. On the credit side of the revenue account, they would see that the passenger fares during the past half-year amounted to £16,429, as against £14,357 in the corresponding period of 1900. Government duty was more in consequence (£328, as against £287), making the net amount £16,101, as compared with £14,070, or an advance of over £2,000. The board considered this satisfactory, and hoped the shareholders would, too. Rents were more by £150 (£213, as against £63), and transfer fees were the same, £10. These figures together gave the total of £16,325 on credit side of the account. On the other side the working expenses during the past six months were £8,937, as against £7,773, or an increase of £1,200, but the ratio of expenses to receipts was a little less—54·78 per cent., as against 55 per cent. As a matter of fact, the actual working expenses for the half-year ending June 30th, 1900, were £9,445 and if the figure of £8,937 (actual working expenses for the past half-year) was compared with it, it would be seen that there had really been a saving of £500. The figure of £7,773 was shown in the accounts for the half-year to June, 1900, because, under the working agreement, the South-Western Company were not entitled to more than 55 per cent., although the actual working expenses might exceed that amount. The difference between the receipts and the expenses was not sufficient to pay a dividend at the rate of 3 per cent. on the ordinary and borrowed capital, and the deficiency (£1,567 on this occasion) was again made up by the working company under their agreement. This made £7,370 retained by the South-Western Company, and if to this they add £263 for general charges, there remained a balance of £8,691 to be carried to the net revenue account. With regard to net revenue account, it began with a balance of £76 brought from the preceding half-year. Then they had the figure of £8,691 just mentioned, also £5 for bankers and general interest and £641 rent charge, payable by the South-Western Company in respect of the generating station, making in all £9,415 on the credit side of this account. On the debit side they had interest on debenture stock, £844, rent charge payable for the terminal station at Waterloo £378, and balance available for dividend £8,192. A dividend of 3 per cent. on the ordinary stock would absorb £8,100, and this would leave £92 to be carried to the next half-year. The number of passengers carried in the past half-year showed an increase of 265,325 over the corresponding period of 1900, and the season ticket holders had increased by 146. There had been an unbroken line of increases since the opening of the line, and although they could wish to see the increases greater, they were not on the whole disappointed.

Sir Charles Scotter seconded the motion.

Replying to questions, the Chairman said that year after year they did all they could to reduce expenses, but they could not compare their line with the Central London Railway. On their line there were only two terminal stations, and they had a further disadvantage of having to deal with a severe gradient.

The report was adopted.

British Electric Transformer Manufacturing Company.

The report for the year ended June 30th last, to be presented to the meeting on the 21st inst, states that the business continues to show a satisfactory and steady rate of increase. After paying all manufacturing costs and expenses of administration, and providing for repairs and depreciation, there remains a net profit of £6,658, which, with the amount brought forward, makes a total available balance of £8,460. The board proposes a dividend at the rate of 10 per cent. per annum (one-half of which was paid as an interim dividend on February 4th last) for the year, to place to reserve fund £2,500, and to carry forward £1,960. The directors point out that, while the capital upon which the dividend is paid has been doubled during the year owing to the vendors' shares now ranking for dividend, the rate of dividend has not been reduced from that paid last year. The board has granted a license to the Union Elektricitäts Gesellschaft, of Berlin, to manufacture transformers in accordance with their letters patent in Germany.

British Electric Traction Company.

The directors have declared the dividend on the 6 per cent. preference share capital for the half-year to the 15th inst.

Baker Street and Waterloo Railway Company.

The report of the directors for the half-year ended June 30th last, submitted to the meeting held yesterday, states that the capital expenditure during the half-year amounts to £276,851. Of this £146,208 has been spent on land, the principal item being the cost of the Indigent Blind School, the site of the depôt and generating station. Negotiations are still proceeding for the transfer of the contracts from the liquidators of the London and Globe Finance Corporation to other parties. The sub-contractors are still proceeding with the works, the most important being the second tunnel under the river, which is making good progress. The engineers advise that, having regard to recent improvements in electrical traction, there will be no difficulty in fulfilling the conditions shadowed forth in the interim report of Lord Rayleigh's committee, and that the railway can and will be worked so as to avoid any objectionable vibration. The engineers report that the western tunnel between the river shaft and Waterloo has been extended to York Road, where it joins the large station tunnel at Waterloo. A length of 20 yards of that tunnel has been constructed, and the tunnel face is within the London and South-Western Company's property. The driving of the eastern tunnel, between the river shaft and Waterloo, was commenced on May 15th last. It has now reached a point 90 yards south of the shaft, the face being partly in clay and partly in ballast, air pressure having been used since June 24th. Northwards, the gap existing in the eastern tunnel between Charing Cross and the Haymarket has been filled up. This tunnel is now complete, together with its large station tunnels between the river shaft and a point in Regent Street, just north of the junction of Conduit Street. The western tunnel was stopped on May 4th at a point in Regent Street, 107 yards north of Vigo Street. Between that point and Waterloo this tunnel is also complete, with the exception of the enlargement required for the station tunnel at the Victoria Embankment. In accordance with the instructions of the directors that the work should be confined to the part of the line south of Oxford Street, the tunnels being driven southwards from Baker Street Station were stopped on May 4th last. The western tunnel had then reached a point in Portland Place, 154 yards south of Park Crescent, and the eastern tunnel a point in Regent's Park, 80 yards from the north side of Park Square. With regard to the station works at Waterloo, the two lift shafts and the stair shaft have all been sunk to the full depth, and preparations are being made to construct the passages from the shafts to the tunnels. At the surface the lift chamber has been walled in and is ready to receive the iron flooring above it as soon as delivered by the makers. At Piccadilly the station works remain as last reported—namely, the passages from the tunnels are complete as far as the shafts, but have not yet been continued round them. At Oxford Street, the adjoining property on the west of the site has been underpinned, the remaining house is being pulled down, when the sinking of the 18 ft. stair shaft will be proceeded with.

Marconi's Wireless Telegraph Company.

The directors have issued a circular to shareholders in which they say that the development of Mr. Marconi's inventions is, in their opinion, making excellent progress, although they do not consider it desirable to publish particulars for the present. Additional expenditure is now required to further the business, to provide for which the directors have resolved to make a further issue of capital, and they now offer the shareholders *pro rata* to their respective holding, 40,000 shares of £2 each on the terms of the enclosed conditional allotment. Messrs. Leonard Clow & Co., representing a financial group including some of the directors, have, in the meantime, agreed to provide the company with a sum of £30,000 on loan at 5 per cent. interest per annum, in further consideration of which the group has received the right to call for the allotment on or before December 31st, 1902, of such shares as may not have been accepted by the shareholders as follows:—(1) In the event of the total number of shares taken being less than 20,000 on the difference between such number and 20,000 at £2 per share, and on the remaining 20,000 shares at £2 10s. per share; and (2) in the event of the total number of the shares so taken being 20,000 or more, on the balance of the 40,000 shares at £2 10s. per share.

British Columbia Electric Railway Company.

The fifth ordinary general meeting was held at Cannon Street Hotel on Monday, Mr. J. Horne-Payne, K.C., presiding (in the absence of Mr. R. M. Horne-Payne, the chairman, in British Columbia). In moving the adoption of the report, he said that the board congratulated the shareholders on the great prosperity of the company. He compared the condition of affairs to-day with their position 2½ years ago, showing the great advance that had been made. The gross earnings for the past year were £102,435, or £27,235 more than in 1898, an increase of 36·19 per cent. The net earnings showed results not less favourable. In 1898, when they invited shareholders to bring in new capital, they were £27,870; for the year that had just expired the net earnings were £41,092, or an increase of £13,212, or 47·4 per cent. That progress had involved an inevitable increase of capital. In a business such as theirs, with a prosperous and constantly growing lighting and traffic, they had to be continually finding new capital. The capital expenditure was shown in detail in the report, and included £52,415 for lighting extensions. The larger that item was the better they were pleased. Every success in lighting meant an increase in net revenue. There was an outlay of about 17s. per lamp upon which they were continually earning a return. There was also the item of the new power house for supplying energy to meet the new demands, and the new machinery, boilers, and rolling stock, the last mentioned to cope with the growing traffic. The board had to be very careful with reference to the demands for fresh capital expenditure however unavoidable, and they might find it advisable in future to recommend ordinary shareholders to reserve their large cash earnings to meet that expenditure.

The report was adopted, and resolutions declaring dividends, re-electing directors and auditors, and thanking the directors, were also passed.

The Central London Railway.

The twelfth half-yearly general meeting of the shareholders of this company was held on 8th inst. at the Holborn Restaurant, Sir Henry Oakley, the chairman, presiding.

Before moving the adoption of the report, the Chairman briefly commented upon the loss his Majesty the King had sustained with the death of the late Empress Frederic. Turning to the report, he mentioned that the company had now 2,800 proprietors on its books as against 2,568 last December, an increase of 232. He thought they could now fairly say that they had made a start in the business of the line. That was the first time they had met after a full six months' working, and it was hoped that the results would be considered satisfactory. The report set out fully and clearly the principal incidents of the half-year. Dealing with the capital account, he stated that the total had not been altered excepting by the issue of the debenture bonds to the contractors, and a small proportion of £84,000 on behalf of the company, which were sold at a satisfactory price. The expenses for the half-year had been comparatively trifling. They had now come to the end of the heavy expenditure, which was the construction of the railway, but so far as the completion of the contract was concerned, they hoped that would be wound up before they met again. There still remained some liabilities, but none of a serious nature. On the whole he thought they had sufficient capital to enable them to carry out all the work they had in hand. It was deemed advisable to extend their boiler works at Shepherd's Bush in order to ensure a constant supply, because they were obliged from time to time to put aside some boilers, and therefore it was a matter of safety for the continuance of the working of the railway to provide more boilers in case of contingencies. During the half-year they had earned £164,823, including £4,100 from sundry items. This was sufficient, after deduction of working expenses, to pay a 4 per cent. dividend on the whole of the share capital, but the deferred shareholders would not receive their dividend until the end of the year's working, according to the company's Acts. But, taking that into account, there was a balance left to be carried forward of £8,583, which was practically £5,000 more than in last December. They had carried in the past six months 20,385,739 passengers, of whom 2,190,000 were workmen, carried at half-price. Those workmen were not located in any particular district on the line, but there were as many to the City as from the City. Those who watched railway returns could estimate how successful and fortunate the company had been when he stated that the earnings were rather more than £950 per mile per week. Railways were generally considered to do well if they earned from £120 to £140 per mile per week, but although the fares of the Central London Railway were so low, the concentration of their traffic was so large that their business yielded over £950 on every mile they possessed, which was very gratifying, especially when they considered the possibilities of the future. He would just mention one incident of recent occurrence which had been of great benefit to the railway, which was the service of trams which had been started from Shepherd's Bush to Kew, Ealing, Acton and Hounslow, and other places. In the week ending April 1st the railway was carrying 130,000 passengers per week to and from Shepherd's Bush, and now they carried 161,000, which showed what the practical development of the suburban traffic had brought to their railway, there being no less than 5,000 additional passengers per day. The working expenses for the half-year were 54 per cent. of the receipts; they were 58 per cent. during the first five months of the working of the line, and about 4 per cent. of those expenses were due to the cost of supplying and maintaining the lifts. They had made arrangements for the letting of the upper part of three of their 11 stations, which should prove a good source of income. In order to provide against any contingencies, the board thought it was advisable to have a reserve for that purpose, and that the balance which they were carrying forward of £8,000 would form a nucleus of such a fund; but before doing anything further in the matter, it was thought advisable to get further experience as to what the wear and tear of the line might be. The company's Bill which had been deposited in Parliament was, in consequence of the influx of Bills of underground railways, referred to a Joint Committee of both Houses to consider and to examine the merits, proposed routes, and particularly with a view of harmonising one with the other, so that the metropolis might be properly served. The Bill had been divided into two parts, the first being in regard to loop lines, and the second for raising further capital of £150,000, and the acquisition of a piece of land for the construction of additional lifts at Shepherd's Bush station. This latter Bill was unopposed, but the first one with regard to loop lines would not be proceeded with this session, and he thought the decision of the Joint Committee hung on the question of vibration. A committee of scientists had been appointed by the Board of Trade to inquire into the complaints

made with respect to the vibration, and the board had given the committee every facility for making experiments, and undertook to make certain experiments themselves in order to see if they could by some modification in the working of the engines so lessen the vibration as to make it innocuous. They were now running over their line a modified engine which bade fair to settle the question. Another experiment was to be made by what was called the multiple-motor system, by which the weight of the engine would be divided over the carriages so as to lessen the impact between the wheels and rails when the train was running. He could not say anything definite at present as to this experiment, nor was he able to say whether the committee would be satisfied with the improvement in their engines, because it had not been before them. He could, however, tell them that the company's engineer had given it as his opinion that the modification would so lessen the vibration that they might dismiss from their minds any further anxiety on the subject. In conclusion, he stated that the board were quite satisfied with the progress of the railway. There had been no serious breakdown since the opening of the line, and also, thanks to their staff, very few complaints had been made.

Lord Colville of Culross seconded the motion, and the report was adopted.

Blackpool and Fleetwood Tramroad Company.—The report of the directors for the half-year ended June 30th last, to be submitted to the meeting to be held on 22nd inst. in Manchester, states that including the sum brought forward, the balance of profit, after providing for debenture interest, is £3,557, and the directors recommend a dividend at the rate of £4 per cent. per annum, which will absorb £3,000, and writing off a sum of £500 to depreciation reserve, leaving a balance of £57 to be carried forward. The number of passengers carried during the half-year was 648,569. The receipts from all sources amounted to £10,183.

City of London Electric Lighting Company.—The report of the directors states that the gross revenue for the past half-year shows an increase of £25,572, as compared with the corresponding period in 1900, while the net revenue is estimated at not less than £50,000 for the six months, as compared with £19,538 a year ago. New customers are increasing, despite competition, and the number of lamps in use shows an advance.

Meetings.—The meetings of the National Telephone Company, and the Baker Street and Waterloo Railway Company, were held yesterday afternoon, and will be reported in these columns next week. Our account of the Liverpool Overhead Railway Company meeting is also unavoidably held over.

Imperial Tramways Company.—The directors have declared an interim dividend for the half-year ending June 30th at the rate of 8½ per cent. per annum. The interim dividend for the corresponding period of last year was at the rate of 7½ per cent. per annum.

Dover Electricity Supply Company.—Mr. H. Hobday has been elected a director to fill the vacancy created by the death of Mr. C. W. Bagshawe.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending August 9th were £524; corresponding week last year, £497; increase, £27. Total to date, £15,316, corresponding period last year, £14,013; increase, £1,303. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending August 10th were £2,143; corresponding week last year, £1,904; increase, £239. Total to date, £7,684; corresponding period last year, £7,787; decrease, £103.

Bristol Tramways and Carriage Company.—The receipts for the week ending August 9th were £3,573; corresponding period last year (Bank Holiday week), £4,061; decrease, £488.

Central London Railway.—The receipts for the week ending August 10th were £5,825; corresponding week last year, £5,043; increase, £782. Total receipts from July 1st (6 weeks), £35,902. Miles open, 6.

City and South London Railway.—The receipts for the week ending August 11th were £1,781; corresponding week last year, £1,555; increase, £226. Total to date, £11,049; corresponding period last year, £9,001; increase, £2,048. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending August 10th were £373 19s. 6½d.; corresponding week last year, £316 18s. 10½d.; increase, £57 0s. 7d. Total to date, £6,606 15s. 11d.; corresponding period last year, £6,156 3s. 10½d.; increase, £450 12s. 0½d. Miles of track open, 3. Car miles run, 1901, 5,451; 1900, 5,201. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending August 9th were as follows:—D.U.T. Co., electric cars, £4,426 19s. 8d.; D.S.D. Co., electric cars, £1,361 12s. 2d.; total, £5,788 11s. 10d.; corresponding period last year—D.U.T. Co., electric cars, £3,729 7s. 5d.; ditto, horse cars, £28 8s. 6d.; D.S.D. Co., electric cars, £999 1s. 6d.; total, £4,756 17s. 5d.; increase, £1,031 14s. 5d.; aggregate to date, £70,680 12s. 0d.; aggregate to date last year, £28,673 8s. 11d.; increase, £1,957 3s. 1d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year. Bank Holiday 1900 and 1901.

Glasgow Corporation Tramways.—For week ending August 10th, the drawings amounted to £12,041 17s. 6d., compared with £8,526 13s. 7d. for corresponding period last year.

Liverpool Corporation Trams.—The returns for the fortnight ended August 3rd show receipts, £19,428: an increase of £1,748. Passengers carried, 4,187,843; an increase of 786,552. 345 vehicles in use, including 6 horse omnibuses. Mileage, 440,243; in increase of 87,773.

Liverpool Overhead Railway.—The receipts for the week ending August 11th were £1,917; corresponding week last year, £1,876; increase, £41. Total from July 1st to date, £10,572; corresponding period last year, £10,375; increase £197. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The smart rally that has taken place in the price of Consols this week comes as a shaft of light into the gloom. With the quotation for Goschens grovelling in the vicinity of 92, investment markets waxed dull beyond description, but now that the Funds have advanced to the still lowly altitude of 94½ a better tone has sprung up in every department. Lord Kitchener's "record haul" encouraged the cheerfuller feeling, and a slight accession of general business is helping to make the Stock Exchange as sprightly as a political garden-party. The hardier tone finds reflection in our lists, but beyond the actual alterations in prices, there is a considerably stronger under-current for many of those securities which are nominally unchanged.

The railway market again demands first attention, from the activity prevailing in Metropolitan and Metropolitan District issues; the Consolidated Stock of the former company is as high as 82, upon persistent reports as to a change in the control of the line Metropolitan District fails to rise much over 29, the present middle price. Central London stocks continue in demand, our favourite Preferred being a point higher, while the Ordinary has risen two. The Deferred, strange to say, fell one, upon more mature consideration as to the warning contained in the auditor's report, to which we directed attention last week. Waterloo and City stock at 92½ is higher, the meeting having brought in supporters. The company is working at the comparatively cheap rate of 54·78 per cent. Taking the railways of Great Britain as a whole, the ratio of expenses to receipts for the past half-year is the enormously high one of 64 per cent.

City and South London stays at 53, and we presume that the new block of 5 per cent. Preference stock has now been thoroughly digested. We wonder how many stockholders there are who had option of applying for this somewhat attractive investment at 112½, the price at which the stock was allotted to certain people. We understand that £50,000 out of the authorised amount of £150,000 has been placed. It is worth noticing that the City and South London 5 per cent. Preference stock of 1891 is quoted at 131½, the 1896 stock of the same class being six points lower at 125½. The company's 4 per cent. Debenture is worth about 114. Central London 4 per cent. Debenture is 115½ for the fully-paid provisional certificates, and in normal times would certainly be considered cheap at 120. But then, times are not yet normal.

In the traction department the issue of the Blackpool and Fleetwood tramroad report has hardly altered the price of the shares, which keep at 14½, although the company still shows a sad falling off from the results it attained up to the end of 1899. The document is no particularly good advertisement for the Blackpool Electric Tramways (South) Limited, the lists for which were supposed to close last Monday. Stock Exchange gossip says that those unwary ones who applied for shares were rapidly furnished with allotment letters. Needless to say, there is no market in the "securities." The electric tramway department is good, without any sensational development, Anglo-Argentines being 4, British Columbia 6¾, Calcutta trams and Dublin United 12. London United Debenture at 106 is unaltered. Shareholders in light railway undertakings chuckled to hear Lord Stalbridge at the London and North-Western meeting on Tuesday, when he confessed that even this premier line was feeling the competition of tubes and such like in the receipts from suburban traffic.

It is quite a treat to have a hopeful report from the City of London Electric Lighting Company to deal with, after the statements of the last few years, breathing alternate indignation and chastened resignation. The company's present report is really progressive, and the competition of the Charing Cross and City notwithstanding, there does seem some hope that the City of London is entering upon a fairer era of prosperity, which it certainly deserves. The Preference shares, however, are dull at 12, and the Ordinary hold fast by 8½. Metropolitan 4½ per cent. Debenture has moved up a point.

In the telegraph market, Anglo "A" is weak upon pressure to sell by tired bulls of the stock. The price, after being 10 for most of the week, drooped to 9¾ on contango days. Eastern varieties are better in several directions, the pre-Ordinary receiving most support. Eastern Ordinary is a little harder, despite Mr. Henniker Heaton's attack upon the company during the second reading of the Pacific Cable Bill in the House of Commons. West India and Panama shares are droopy, and Chili Telephones are weak, although the report was very satisfactory. Nationals, on the other hand, display considerable vitality. All the old talk of negotiations with the Government is being revived, and the effect of the pourparlers is already discounted to the extent of half-a-sovereign, which Nationals have added to their price this week. Construction shares are good, both Henley's and Callender's improving 10s. each in the Ordinary issues.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for he last three years. 1898.	1899.	1900.	Closing Quotation Aug. 7th.	Closing Quotations Aug. 14th.	Business done during week ended Aug. 14th. 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —101 xd	98 —101 xd	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,200 Red.	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	52 — 55 xd	52 — 55 xd	51½	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99 xd	97 — 99 xd	98	97
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	9⅜— 10¼	9⅛— 10	9⅞	9⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3¾— 4¼	3⅝— 4¼	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185 xd	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	103	...
16,000	Cuba Telegraph	10	8 %	7 %	...	6½— 7½	6 — 7	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½ — 15½	14½ — 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99—103% xd	99—103% xd	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½— 11½	10½— 11½	...	...
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	141 —146	142 —147	145	142
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	92 — 95	94 — 97	95	94½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	110 —114	112 —116	...	...
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13⅜— 14¼	13⅜— 14¼	14⅛	13⅞
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	110 —115	110 —115	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼ %	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	10¼— 10⅜xd	10¼— 10⅜	10 9/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜— 15¼xd	14⅜— 15¼xd	15 1/16	14⅜
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	31 — 33	31 — 33	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	41 — 45	41 — 45	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	2½%	...	¼— ⅜	¼— ⅜	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝— 1	⅝— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3¼— 3½	3⅜ - 4	4⅛	3¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅛— 4⅜	4⅛— 4⅜	4⅜	4 5/16
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	89 — 92	89 — 92	90⅜	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	94 — 97	94 — 97	96¼	95
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102 xd	99 —102 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,006	United River Plate Telephone	5	6 %	7 %	...	5 — 5⅛xd	5 — 5⅛	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅞— 5¼ xd	4⅞— 5¼xd	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104 xd	101 —104	...	...
171,000	West African Telegraph, 5 % Debs.	100	...	...	...	101 —104	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜—14¼ xd	13⅜— 14¼	14 1/16	13⅜
75,000£	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	101 —104 xd	101 —104 xd	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103 xd	100 —103 xd	...	...
88,321	West India and Panama Telegraph	10	2 %	⅝%	...	⅜— ⅝	¼— ⅜	¼	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	5 — 6	4½— 5½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref.	5	...	...	...	8¼— 8⅜	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5½— 6	5½— 6	...	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	107 —110	107 —110 xd	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	6 %	4 %	0 %	8 — 9	8 — 9	8⅛	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13 xd	12 — 13 xd	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	120 —125 xd	120 —125 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	4 %	4 %	8½— 9½	8½— 9½	8⅝	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12¼	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red.	...	...	...	...	103 —106 xd	103 —106 xd	105	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5⅜— 6¼	5½— 6 xd	6⅛	6
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6 xd	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	103 —106	102 —105 xd	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12 xd	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104 xd	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1¼— 1⅝	1¼— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13 — 14	13⅜	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	108 —111 xd	108 —111 xd	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	94 — 97 xd	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15 — 16	15 — 16 xd	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½xd	14½— 15½xd	15	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½xd	...	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	97 —100 xd	97 —100 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90 xd	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	3 1/16	3
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	13 %	10½%	11½— 12	11½— 12½	12	...

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Aug. 7th.	Closing Quotation Aug. 14th.	Business done week ended Aug. 14th, 1901. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	90½	90
45,000	British Electric Traction	10	6 %	8 %	9 %	13¾ — 14¼	13¾ — 14¼	...	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 12½	12 — 12½	12 7/16	12¼
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11 xd	9½ — 10½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6 — 6¼xd	6 — 6¼	6¼	...
50,000	¶Browett, Lindley & Co. (1893), Ord.	£1	...	...	8 %	...	7/8 — 1	...	...
50,000	¶ ,, ,, ,, 6 % Cum. Pref.	£1	...	...	6 %	...	1 5/16 — 1 1/16	...	...
90,000	Brush Elecl. Engin., Ord., 1 to 90,000	2	5 %	6 %	...	1½ — 1¾	1⅞ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2⅛ — 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102 xd	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 —15	14½ — 15½	14 15/16	14⅞
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5⅝ — 6¼	6	5⅝
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	107 —111 xd	107 —111	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	99 — 102	101 — 104	104	99¼
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	102 — 105	101 — 106	105½	102
440,100	Do. do. Def. do.	Stock	...	...	...	98 — 101	97 — 100	98	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	52 — 54 xd	52 — 54 xd	53	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5¼ — 5⅝	5¼ — 5⅝	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	8 %	3½ — 4	3½ — 4	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105 xd	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	0 — ¼	0 — ¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85 xd	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	85 — 90	85 — 90	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½ — 2	1½ — 2	1 3/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2¼ — 2¾	2¼ — 2¾	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102 xd	98 —102 xd	100½	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾ — 10¼	9¾ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16½	16 — 17	16¼	16 1/16
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	103 —113	109 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅜%	3½%	7¼ — 7¾	7 1/16 — 7 3/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13¼	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	37 — 41 xd	37 — 41	40¼	39
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...%	...	101 —104 xd	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½ — 11½	10¼ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5¼ — 6	5¼ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 93	91 — 94	93	92¼

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜
National Electric Free Wiring, 12/6 paid, 11—11½.
* From Birmingham Share List.
¶ From Manchester Share List.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, August 14th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ...	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23	£23	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¾d.	8¾d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£294	£294	..
b ,, Sheet, in ton lots ..	per ton	£191	£191	..
p Babbitt's metal ingots..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 9" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed)	per lb.	11d.	11d.	..
,, ,, (solid drawn) ..	per lb.	10½d.	10½d.	..
g Copper Bars (best selected) ..	per ton	£83	£85	£2 dec.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
e ,, (Electrolytic) Bars ..	per ton	£82	£82	..
e ,, ,, Sheets ..	per ton	£90	£90	..
e ,, ,, Rod ..	per ton	£84	£84	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/6½ to 3/8	3/6 to 3/7	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	45/10	46/4	6d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£12 to £12 2 6	£12 5	dec.
g ,, ,, Sheet	per ton	£13 5	£13 10	5s. dec.
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	9d. to 9d.	9d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£118 to £119	£120 to £121	£2 dec.
g ,, foil	per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8¼d.	8¼d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works Co., Ltd. g Messrs. James & Shakspeare. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yeo & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

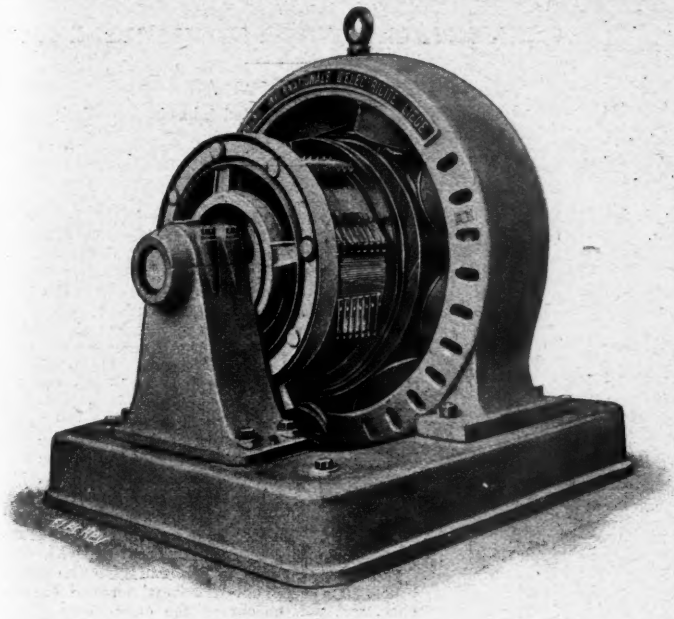


Fig. 1.—500-kw., 550-volt Traction Generator.

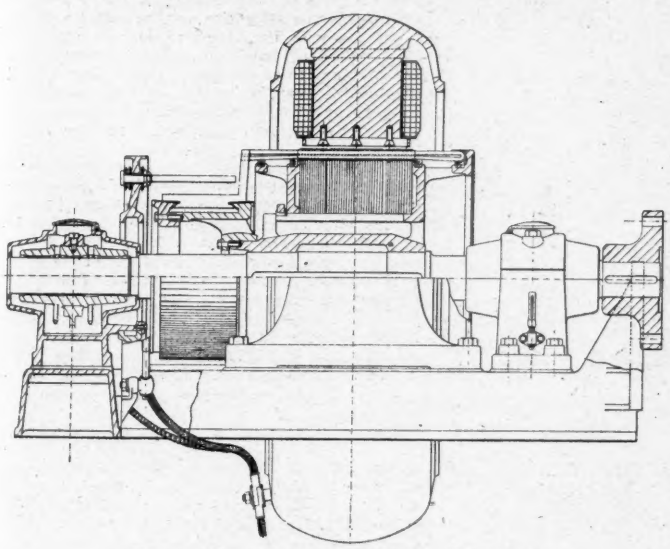


Fig. 2.—Cross-Section of 500-kw. Generator.

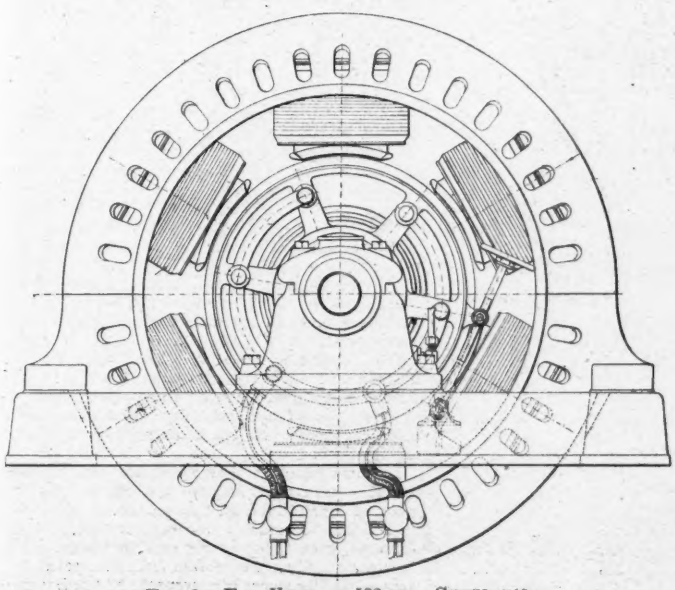


Fig. 3.—End View of 500-kw. Generator.

THE INTERNATIONAL ELECTRICAL ENGINEERING COMPANY'S DYNAMO.

We illustrate herewith a dynamo which may possibly become well known in central station work, the International Electrical Engineering Company of Clun House, W.C., having recently received orders for similar machines from the Corporations of Hull, Dundee and Bristol, besides many private firms.

Those who have seen the exhibit of the principal house of this firm—Compagnie Internationale d'Electricite, of Liège—at the late Paris Exhibition, or the machinery driving the *Glasgow Herald* press at the Glasgow Exhibition, will no doubt have particularly noticed the shapely lines which the Liège firm manage to work into their machines. There is no doubt that a neat and workmanlike appearance goes for something nowadays, and the company in question appear to have thoroughly appreciated the fact. Fig. 1 shows a photo of the machine, and figs. 2 and 3 are cross-section and end view respectively of a 500-kw. 550-volt traction generator for coupling direct to a Belliss high speed engine. Two bearings are fitted to this particular dynamo, as they were particularly asked for, but as a rule the dynamos have one outside bearing, and the armature hub is extended for bolting direct to the engine flywheel. This is being done for the Dundee and Bristol dynamos. The armature is drum wound; the core being built up of annealed stampings of high magnetic quality which, before punching, are evenly insulated by a paper pasting machine. Ample provision is made for ventilation, and the core is slotted on the exterior surface to receive the conductors, the slots being lined with built up mica insulation which the firm manufacture for themselves. The armature conductors are accurately shaped on formers, so as to be interchangeable throughout, and when they are all in place they form a complete barrel winding as shown in fig. 4. Fig. 5 shows the armature of a 1,000-kw. machine under construction.

The commutator is constructed of hard copper segments, insulated from each other by mica specially selected to wear down at an equal rate with the copper. The segments are built up under hydraulic pressure, and are held at the ends by V-shaped micanite rings. It will be noticed from fig. 2 that the supporting drum is attached direct to the armature—not keyed to the shaft, so that both armature and commutator can, if desired, be dismounted together, and there is no possibility of relative movement between the two.

The brush rocker is said to be more than usually strong, with large bearing surfaces to the rocker and brush spindles, this, it appears, being a special feature of all the machines made by this company. It will be noticed that the brush spindles may, if necessary, be readily withdrawn without dismantling the rocker in any way, and the cap of the bearing may also be removed without interference with the rocker. The brush-holders are of the spring type, the fixed parts being amply proportioned, and the moving parts of as light weight as is compatible with necessary strength. The carbon blocks are of special quality, to work sparklessly, and reduce heating of the commutator to a minimum. The company, it may be mentioned, are in a specially favourable position, in that they have their own carbon factory.

The magnet yoke ring is of special cast dynamo steel of ample section, made in halves, the poles being cast with the yoke. The firm prefer a cast-steel yoke to one of cast-iron, because the poles can be cast in one piece with it. There is thus a minimum number of magnetic joints, and the sectional area being much smaller, both the space occupied and the weight are less, whilst as there is a much less leakage surface the efficiency comes out higher. In order not to spoil the symmetry of the machine, the bolts fastening the two halves of the yoke together are hidden away inside the side flanges. Separate laminated pole shoes are provided for each pole, the horns of which are specially shaped to reduce eddy and hysteresis losses to a minimum, and at the same time to enable commutation to be made sparklessly. They are made so as to be easily removable by hand. The polar surface is bored out concentrically with the armature bearings, ample clearance being allowed to ensure safety in running. The field coils are neatly arranged

for easy withdrawal and are accurately adjusted to give equal magnetic values to each pole. This is a point which some makers seem to overlook.

The shaft, of best selected mild steel, is ground up after being turned, and is specially shaped at the bearings to prevent oil creeping.

The bearing is lubricated automatically by loose rings resting on the shaft and dipping into an oil reservoir, the rings being of hollow section to lift a large quantity of oil even when running at such low speeds as less than 200 revolutions per minute.

The terminals have ample conducting surfaces, and their design is such that the connections cannot become loose by vibration.

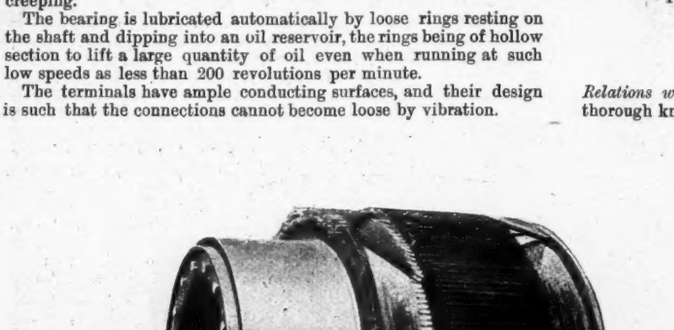


Fig. 4.—500-kw. Armature.

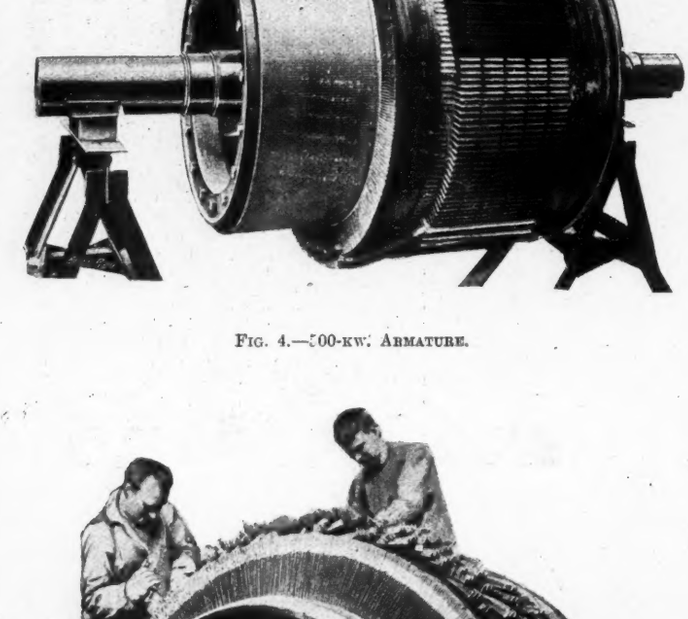


Fig. 5.—1,000-kw. Armature.

We may mention that the firm's interests in the United Kingdom and the Colonies and Egypt are in the hands of Mr. E. Kilburn Scott, A.M.I.C.E., M.I.E.E., whose name is well known to readers of this paper.

THE CENTRAL STATION SUPERINTENDENT.

By J. H. VAIL.

The prize-winning paper, reprinted from the New York *Electrical Review*.

(*Concluded from page* 248.)

Relations with Employés.—The superintendent should possess a thorough knowledge of human nature and the peculiarities of men, that he may wisely select his subordinates with a view to the particular ability of each individual, and he should always have men ready in the line of promotion. The superintendent who has laboured in the ranks as a private has obtained a valuable knowledge of the characteristics and environment of the workman. He not only knows the worth of each class of labour, but he has the prestige of having such a thorough practical knowledge of the details of the business, that his superiority is readily recognised by his subordinates. He will readily concede that the most humble subordinate may offer a valuable suggestion, and he will appreciate that the work done by the intelligent individual quickens his observation. Therefore, consultation with subordinates who are in daily contact with the several features of operation will give the superintendent the benefit of others' personal experience, and will encourage the employé to study more closely the particular features of his own work.

It is not a difficult matter to select a force of men which is not only competent but, if treated with proper consideration, can be relied upon to co-operate with the superintendent in attaining his standard of excellence. The superintendent cannot afford to retain incompetent, discontented or disloyal men, or those of bad character. Favouritism should not exist, and an employé with a political pull will sooner or later cause trouble.

It will be of advantage to the superintendent to come in frequent personal contact with every employé of his department. The happy faculty of knowing each employé personally not only gives the superintendent a knowledge of the personal character of his subordinates, but it tends to the establishment of a higher *esprit de corps* than can otherwise be attained. Strict integrity, justice and square dealing should be firmly established between the superintendent and his subordinates. The efficiency of the operating force can be vastly improved by using reasonable efforts to elevate the character and improve the conditions of employés.

The rules necessary for the regulation of the business should be stated in plain language, to the end that exactly what is required of him will be conveyed to the employé, and the orders must be so definitely expressed that execution is not difficult. No business of the magnitude of a large lighting station can be conducted without careful attention to the discipline of the force; where proper thought precedes the establishment of regulations, strict attention should be given to their enforcement.

Regular employés should not be dismissed or suspended except for sufficient cause, and, in any event, the delinquent should be given a hearing, and allowed a fair opportunity to state his side of the case. Where leniency is allowable, it will, if applied with discrimination, no doubt instil in the man a higher sense of duty. When vacancies occur, or when new positions are created, then it is that promotions should be made as a recognition of loyalty and faithful service. This affords one of the best opportunities of proving the appreciation of faithful service. When promotions are not possible, a kindly word of appreciation will be highly treasured by the recipient.

Analysis of Costs of Operation.—The superintendent must fully realise the importance of a careful analysis of every item entering into the cost of operation, distribution and maintenance. The superintendent is the one man held responsible for the economical manufacture of the company's product, and the satisfactory distribution and delivery thereof to the consumers at a profit-making basis.

He must maintain a close familiarity all along the line with every factor that enters into the costs of operation and maintenance. Most of the large electric lighting companies have their accounts so classified and sub-divided, with the costs reduced to the kilowatt-hour basis, that the superintendent can obtain from the accounting department such data as readily shows him wherein he can improve

in the future over past conditions. He should keep in touch with the most advanced practice of similar concerns and strive to improve upon it.

As the large majority of central lighting stations are operated by steam power, wherein the cost of coal is a conspicuous percentage of the total cost of current production, it becomes an important factor that the superintendent should have a thorough knowledge of the relative values of the different qualities of coal, the most advanced practice of firing furnaces and the details of handling boilers to obtain the highest economy. It is probably safe to hazard the statement that the superintendents of a large percentage of the stations in the United States can save to their companies a very considerable proportion of their salaries in this one item, if they will devote to it the kind of attention needed.

Another leading opportunity for economy is in the maintenance of the plant and system. Rules requiring frequent, intelligent and rigid inspections throughout, and a proper report thereon, will place before the superintendent the exact condition of every machine and appliance under his supervision. He becomes informed where repairs, if done at once, will be comparatively inexpensive in cost, and will avoid accident and more costly repairs at a subsequent date.

It may be stated, again, that in this direction the practical experience of the superintendent previously obtained by his earlier years of service in the ranks will give a finer appreciation of these points than can possibly be conceived by the superintendent who is without such training.

New Construction.—We cannot here determine whether our superintendent will have charge of an antique or a modern station, but in either event he will, in all probability, be required largely to increase his plant or extend his system. It is on such occasions that his knowledge of up-to-date practice must be practically applied. He must now decide upon the relative values, efficiencies and adaptability of new equipment, and it is evident that his knowledge must not be limited or his judgment confined to narrow lines.

He should have no prejudice in favour of any particular system, machine or individual manufacturer, but, being fully acquainted with the problems he has to meet and having a fundamental knowledge of all the questions involved, he should be prepared to state clearly to his directors the kind of equipment best adapted to meet the conditions, the cost of its installation, the economy of its operation and the profit to be derived when it is in service. He should advocate the introduction of such appliances as will lower the cost of production to the greatest extent. It will thus be evident that the superintendent should have keen judgment to analyse all points. He must have sufficient foresight to anticipate what will be the requirements of his company in the future, to the end that he builds not only to meet the conditions of present emergency but on such lines that future developments are proven to have been economically anticipated.

Position and Authority.—The superintendent, when selected and installed in his position, should be paramount. The limits of his authority should be definitely prescribed, and within these limits he should be supreme. He will be held fully responsible for the results he produces, and for the success or failure of his administration, therefore he should be recognised as the one man in power having full responsibility. There should be absolutely no interference with his methods or rulings, and no appeal from his decision. If he be a man worthy of the position, he should also be worthy of the fullest confidence of his employers.

The man clothed with the authority of a superintendent should, above all, not be egotistical, or subject to "swelled head;" such a fault on his part will depreciate his value, no matter how competent a man he may be in all other respects. His authority, while absolute, can be exerted in a quiet, gentlemanly and effective manner that will secure cheerful and willing co-operation from his subordinates. Should he fail to meet the requirements of his employers, a quiet conference will best inform him, but knowledge of this should not reach his subordinates.

Every effort should be made on the part of the superintendent to cultivate perfect harmony with the business management. The public are very exacting in demanding a high order of efficiency in the electric lighting service, and to the full attainment of this end there should be, on the part of both departments, a high appreciation of the value of cordial co-operation in the effort to give first-class service. Complaints are sure to be made, and accidents more or less serious will occur occasionally, causing inconvenience to patrons, even in spite of the most intelligent care and strenuous efforts to maintain a perfect service. It is on such occasions that the business management and the board of directors should fully support the superintendent. It is fair to assume that the superintendent knows his business, and all his reasonable requirements for the benefit of the service should be cordially conceded.

Persistency rightly applied is a character that will be required by the superintendent in a large measure. There are, no doubt, other lines of work offering smoother paths and pleasanter fields than the supervision of an electric light station and system. Occasions arise to test the patience and try the soul of the superintendent, and the man who is easily discouraged or lacks abundance of perseverance is not the one who can successfully contend with the inherent faults in apparatus combined with the numerous difficulties sure to crop out in unexpected directions.

The superintendent should cultivate system and order and accuracy in all his business methods, and should not fail to inculcate the same with his subordinates. Slovenly methods cannot be afforded.

THE "DISCOVERY" ELECTRIC LIGHTING PLANT.

The ss. *Discovery* has taken out with her to the Antarctic Regions probably as unique an electric lighting plant as has ever been supplied to any ship sailing under his Majesty's flag.

The plant in question has been designed especially for her by

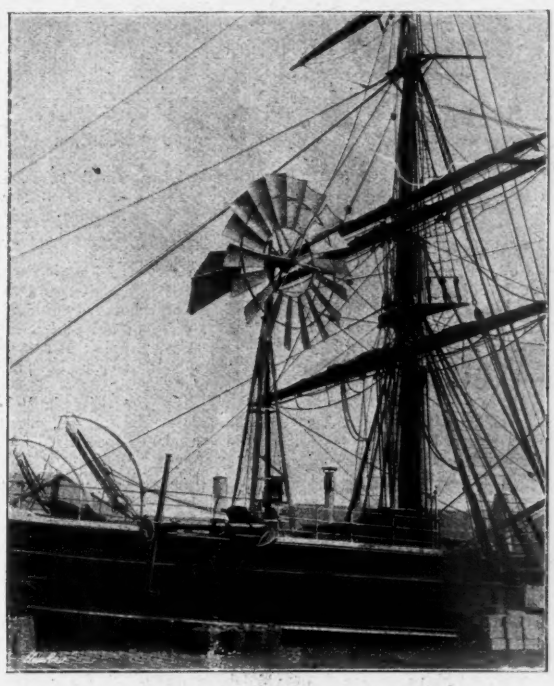


Fig. 1.—The "Discovery," showing Windmill.

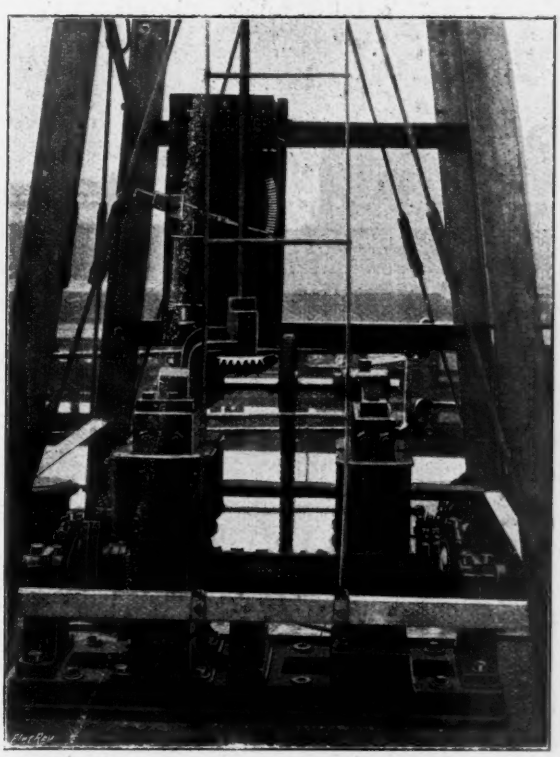


Fig. 2.—Newton Dynamo.

Mr. Arthur Bergtheil, of Messrs. Bergtheil & Young, who have executed the work. Since it will be of the utmost importance to husband fuel of every description, and an impossibility to replenish stores in the regions to which the ss. *Discovery* is bound, it became necessary to find a method of driving the generators used for the supply of electricity without the employment of

steam. The great difficulty hitherto found in using wind as a motive power for electrical purposes has been that the dynamo could not be made to run at a constant speed, due to the fluctuations in the speed of the wind. This difficulty has been overcome by Mr. Arthur Bergtheil by using two generators, the one opposed to the other when mounted on the same shaft, with the result that with the dynamo running at a speed varying from 500 to 2,000 revolutions per minute a practically constant voltage was obtained.

The entire plant is very compact, and is so designed that it can be stored away in the hold of the ship until she arrives at her destination. In the event of it becoming necessary to light observation cabins or instrument sheds in the vicinity of the vessel, flexible cables have been provided with lamps attached so that these may be illuminated from suitable plugs placed about the ship. The windmill is so designed that it may be placed complete with its dynamos at a distance of 200 yards from the vessel for the purpose of obtaining the very best results from the wind, and connected to the vessel by means of a large armoured cable wound on a drum.

The windmill is 20 ft. high, with a driving wheel 12 ft. in diameter, developing in a 15-mile wind something like 3 H.P., geared to drive the vertical shaft at 200 revolutions per minute and the driving wheel of the generator at 500 revolutions per minute.

Commander Scott will thus be ensured a good light when steam is out of the question, driftwood not to be depended upon, and the burning of oil or blubber impossible. Many experiments were made with the windmill before the best results were obtained, and Mr. Arthur Bergtheil sailed with the ship, accompanying her some distance, so as to see the finishing touches made to the plant, and adjust the automatic devices while she was under way.

The windmill was manufactured specially for this plant by Messrs. Alfred Williams & Co., of Old Ford Road, Bow, and is of American type, so constructed that it can be easily shifted from one point to the other or packed away in a small compass. The dynamo was built specially for this installation by the Newton Electrical Works, Limited, of Taunton.

"COLUMN TYPE" INDICATING AND RECORDING METERS.

A novel and unique type of volt and amperemeter, for which high qualities are claimed, is being introduced to this country by Messrs. Blackwell & Co., Limited. The principle on which its operation is based consists in causing the variations in the current to be measured to control the variation in pressure of a body of air in a closed vessel, this variation being in turn indicated or recorded by the rise and fall of a column of non-volatile liquid in a glass tube.

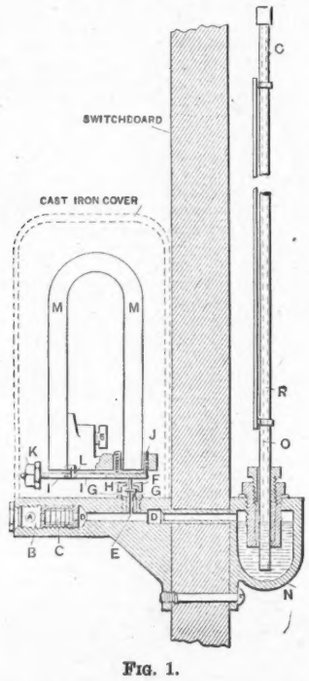


Fig. 1.

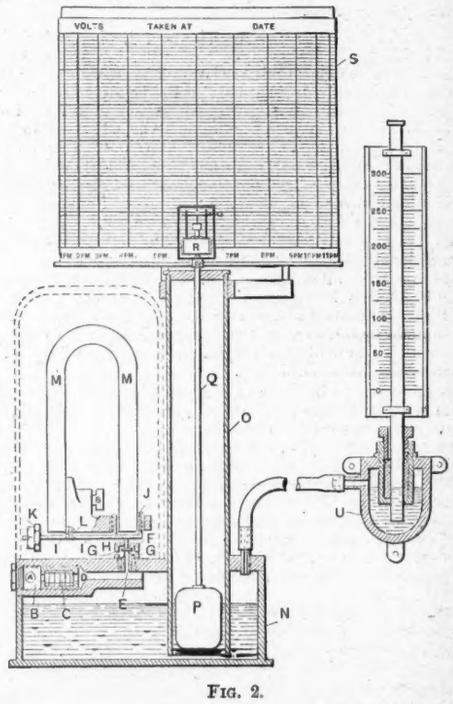


Fig. 2.

In fig. 1, assume for the time being that some source, say a small pump, is delivering air at a fairly constant pressure of about 1¾ lbs. per square inch through the pipe A. This enters the chamber B, and then flows through a series of porous diaphragms made of filter paper, whose prime function is to serve as an air resistance, and which incidentally remove any dust particles. The air then enters the passage D, into which is drilled the opening E, which is capped by the valve, F. The valve consists of a small flat disc of non-oxidisable metal resting on a circular seat, with escape ports G below it and a pin, H, resting on top. On the pin rests a spool, J, carried by one end of the lever I, on the other end of which is a counter-weight, K, by means of which the effective weight on the pin H can be adjusted.

The spool is wound with wire through which the current to be measured is passed, this being done *vid* two short thin copper ligaments L, which support and form the pivots about which the lever can oscillate.

A magnet M furnishes a field of force such that the reaction between it and the current forces the spool down with a force increasing as the current increases. The valve F is thus a variably loaded safety valve, whose blowing-off point is constantly and proportionately varied by the current variation. The counterweight, K, on the lever is so adjusted, that when no current is passing through the spool, the weight on the valve pin is such, that the blow-off pressure in D is sufficient to force the liquid in the closed chamber N up through the glass tube O to a height R, which is therefore the zero of the scale. The pressure cannot go above this when no current is on, as any tendency to increase simply results in lifting the valve slightly higher, whereupon more air escapes and the pressure falls back, nor can it go lower, as if there were this tendency the valve would partially close, because of the spool's weight, and the less rapid escape of air through it would cause the pressure to build up again, on account of the constant flow of air from the high pressure supply at A through the air resistance C.

Exactly the same thing holds good when the weight on the valve is that due to the non-counterbalanced portion of the weight of the spool plus the downward thrust caused by a given current through it. This gives what is practically a heavier loaded safety valve, so that the blowing-off pressure in N is higher, and this forces the liquid up further in the glass tube, thus showing the presence of a current. The height to which the liquid rises is directly a measure of that current, because the extra downward thrust on the spool is, from the magnetic field and spool design, proportionate to the current.

The air resistance C not only prevents the action from being so sudden that the indications are not dead beat, but in the case of a decrease in current strength allows the air in the closed chamber N to flow back promptly, and so register the decrease, instead of having the greater part of the escaping air furnished from the higher pressure source A. The glass tube being but 24 in. long, the pressure at A (equivalent to about a 49-in. column of the liquid) is always sufficiently in excess of that in the passage D and the chamber N to cause the changes to be promptly registered.

From the foregoing it is seen that the zero adjustment is made by screwing in or out the counterweight K, thus shifting all scale values an equal distance up or down the tube. For actual calibration before shipment an iron screw S of heavy cross-section is provided which, on being brought closer to or taken further from the opposite leg of the magnet, weakens or strengthens the field in which the active spool works by shunting a portion of the lines.

The total motion of the spool is exceedingly small—less than a hundredth of an inch, in fact—and therefore there is not only no spring action of the suspending ligaments, the action in this

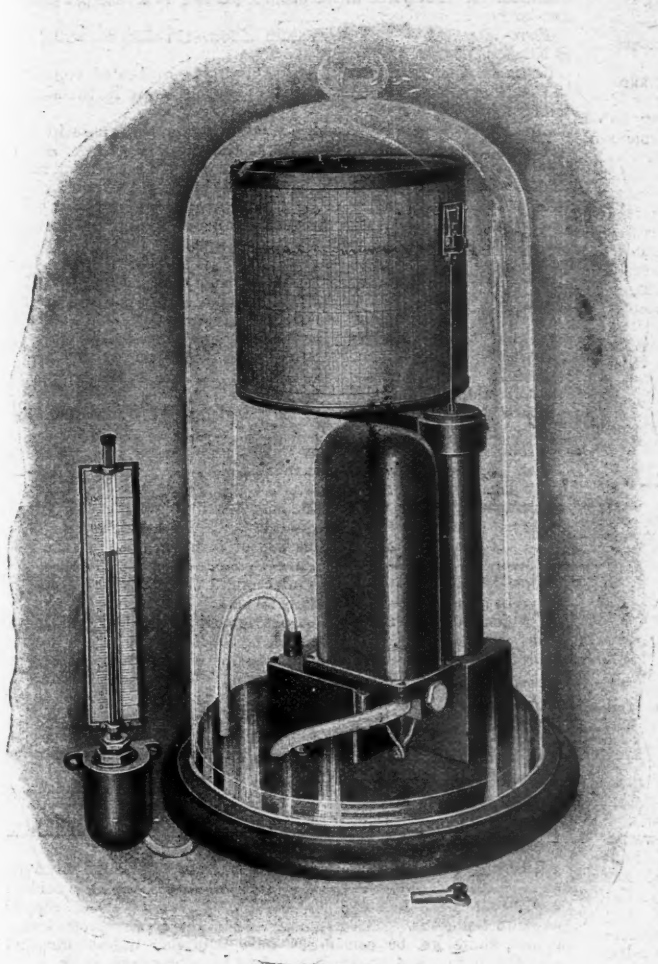
rators used for the supply of electricity without the employment of

particular being like that of the Kelvin balance, but as the spool acts always in the same field, the pressure it exerts on the valve, and hence the air pressure in N, and the resulting liquid column height, are exactly proportional to the current strength. In other words, the scale divisions are absolutely evenly spaced.

It should also be noted that the only work that the varying current has to perform is to *control* the air pressure; the actual energy required to move the liquid, and so show the variation, is supplied by an independent source whose power is, comparatively speaking, unlimited.

The length of scale adopted as standard is 18 in. from the zero to the maximum reading, and this, combined with the conspicuous colour of the liquid employed (a mineral oil coloured a deep clear red or a dark yellow, as may be desired) results in making the indications exceptionally legible.

Within extremely wide limits, variations in the pressure of the air supplied to the instrument through the pipe A have no influence whatsoever on the accuracy of the meter readings, this being because it is the *weight* on the safety valve, and not the *quantity* of air flowing through the valve, that determines the blowing-off pressure of the air in the passage D, and the closed chamber N, and therefore the height to which the liquid rises in the tube. As long as the supply



Standard Pattern of Direct Current Recorder and Indicator.

pressure is sufficiently in excess of the blowing-off pressure in the closed chamber to cause a continuous flow of air to take place through the air resistance C, the meter will indicate correctly, although the rate of speed of the column movement when the current changes will be slightly less or greater as the supply pressure is lowered or raised.

Experience has shown that dial illumination is entirely superfluous with this instrument, as the liquid is an excellent reflector, and the ordinary station illumination renders it visible at great distances.

Owing to the extreme sensibility of the instruments, a 20 to 25-millivolt drop for full scale indication in an ammeter being perfectly feasible, there is ample margin for adjustment, and all these instruments are standardised, so that the same drop is required for each, thus making all shunts strictly interchangeable, and all meters, whatever their range, intercomparable.

The space occupied by the "column" type meters is very small. The extreme over-all width is $2\frac{3}{4}$ in., and owing to the design of the magnet fields and the effective shielding of the protective caps over them, they can be mounted on centres but 3 in. apart, without mutual interference. The space occupied behind the board (see fig. 1) is $2\frac{3}{4}$ in. wide × $10\frac{3}{4}$ in. high, and on the face of the board $2\frac{3}{4}$ in. × 27 in., and the drilling required for mounting is only three holes, $\frac{3}{16}$-in. diameter, to hold the mechanism in place, and one, $\frac{1}{16}$-in. diameter, for the passage connecting the chambers D and N (fig. 1).

The recording meter employs exactly the same principle as the indicating type. Instead, however, of using a rising and falling liquid column in a glass tube to give visual indications of the current changes, the column is made of much larger diameter, and carries a hollow float supporting a rod with a pen at the extremity thereof, which in turn traces a line on a sheet of paper carried before it.

By making the column diameter of a proper size a float of such power can be used that the pen friction becomes negligible compared with it, and the pen can be made to carry a large supply of ink sufficient for long records without destroying the accuracy of the indications by the variation in weight.

The accompanying fig. 2 gives a section of this recorder, similar parts being lettered the same as those in fig. 1. It will be noted that the only additions comprise the float P, the rod Q, and the pen R, together with the drum S, which is rotated 1 in. an hour by internally placed clock-work, and to the surface of which is secured the record paper. A pen stroke of 6 in. has been adopted for the recorder scale and a drum circumference of 24 in.

Owing to the absolutely dead-beat indications which this class of apparatus gives, the meters never run over, *i.e.*, any fluctuations shown by them are true fluctuations, and their values are not added to by the inertia of the moving parts.

By drilling an additional hole through the cap forming the top of the chamber in which the liquid is contained, and connecting this by a tube with a second closed vessel U, similar to N in fig. 1, the liquid in the tube dipping into this vessel will rise and fall with the rise and fall of the pen, as the variation in the pressure of the air therein is the same as that in the recorder chamber. In this way it is possible to put the recorders themselves in the engineer's office or elsewhere, so that they cannot be tampered with, and place the pilot indicator on the switchboard, so that the attendant will have before him a constant indication of what the recorder is doing. Any number of these pilot stations can be provided.

To furnish the air required for the operation of these instruments, two separate devices are available.

The first is a simple, single-cylinder, single-acting air pump, mounted on a square iron box which serves as an air reservoir, and driven by a $\frac{1}{20}$th-H.P. motor suspended underneath and connected to the pump by a belt. This type is of sufficient capacity to run 50 indicators or 12 recorders, the construction of the latter being such that they require nearly four times as much air as the former.

The second type is a water-driven compressor, which operates like an injector, the water carrying the air with it and compressing it to the desired point. These require about 10 gallons of water per hour per instrument, with 3 ft. head, and are built in sizes to suit the particular installation.

THE BRITISH EMPIRE LEAGUE AND STATE-OWNED CABLES.

At the annual meeting of the British Empire League which was held at Manchester on Wednesday, July 31st, under the presidency of Lord Egerton of Tatton, some of the principal subjects dealt with in the report of the Council were—commercial union between Great Britain and the Colonies, the State ownership of cables, and Imperial defence. The following letter from Sir Sandford Fleming was read to the meeting:—

"Edinburgh,
July 30th, 1901.

"C. Freeman Murray, Esq.,
"*Secretary*, The British Empire League.

"Sir,—Having been appointed to represent the League in Canada on the Council, I deem it my duty to give expression to the strong views held by the Canadian branch on the subject of a Pan-Britannic cable system.

"Within the past few years the subject has been discussed at length. At the annual meeting in February, 1900, on which occasion several members of the Canadian Government took part, resolutions were unanimously passed urging the adoption of the principle of State ownership and control of cables connecting the British possessions in any part of the globe, and that in every case when private companies applied for permission to lay cables, landing rights should be granted only on condition that the Crown could at any time assume possession on specified terms.

"At the succeeding annual meeting (February 13th, 1901) these resolutions were reaffirmed, and it was unanimously resolved, as a further step towards consolidating the Empire, that means should be taken without delay to nationalise, not only all cables between British possessions, but all landlines in the British dominions. The latter resolution had special reference to the Canadian land telegraph lines, for the reason that Canada is the only country

within the Empire where the telegraph system is not assumed by the State.

"It is proper to mention that public opinion in Canada is largely in favour of State ownership and State control of telegraphs and cables, and it has been announced by the Postmaster-General that a proposal is entertained by the Government to transfer to the management of the Post Office the land telegraphs of the Dominion, and further, that the Canadian Government is likewise considering the question of laying a cable between Canada and Great Britain.

"It will at once be apparent that, with a State-owned cable across the Atlantic, with the Canadian landlines nationalised, with the Pacific cable completed, and the Australian system of telegraphs already in the hands of the Government of the Commonwealth, there will be a continuous chain of State-owned cables and telegraphs from the heart of the Empire in England to the Western confines of Western Australia. By this combination of electric lines no less than two-thirds of the circumference of the globe will be girdled by a State-owned telegraph system. Moreover, this combined system may reasonably be looked for in the near future, possibly by the time the Pacific cable, now under contract, shall be completed. The postal telegraph system of the United Kingdom will then be in direct connection with similar postal systems in Canada, in New Zealand and in the Commonwealth of Australia. To complete the Pan-Britannic telegraph system it will only be necessary to connect Asia and Africa by State-owned cables extending from Western Australia to the Cape, Ceylon and India.

"In view of these facts, and in view of the enormous importance of securing throughout the Empire the freest and cheapest means of communication, on behalf of the League in Canada, it is my duty to point out how extremely desirable it is that provision be now made for ultimate State-ownership of cables across the Indian Ocean.

"The permanent unity of the Empire is, according to the Constitution, the primary object of the League. We in the outer Empire feel very strongly that the Pan-Britannic telegraph system is practically indispensable to that object. That, at least, is the view held in Canada, and there is evidence to show that it is shared in Australasia and in all the other great British possessions.

"Such being the case, it is important that members of the League in England, Ireland and Scotland should have a fuller knowledge of the prevailing convictions of British people elsewhere. The completion at the earliest possible period of a postal cable service to connect all the King's dominions beyond the seas with each other and with the mother country, is a matter which vitally concerns all our people. I ask you, therefore, to bring the subject of this letter to the attention of the Manchester meeting.

"I have the honour to be

"Your obedient servant,

"Sandford Fleming."

Sir Edward Sassoon, M.P., also wrote in favour of the principle of a State purchase clause being inserted in all contracts or licenses in cases where the State conceded landing privileges to private companies.

The Earl of Onslow moved the adoption of the report. After referring to the proposed alteration in the King's title as "an additional link binding the Throne to the Empire," and to the tour of the Duke and Duchess of Cornwall and York as an event that would be "of lasting benefit to every part of the British Empire and of not altogether indirect benefit to the Royal couple themselves," Lord Onslow said there was one example of the growth of the Empire which in some respects might not be looked upon as favourable, but which, in other respects, had its favourable side; he referred to the bill which this country would have to pay for the increase of cable communication between different parts of the Empire. That bill was enormously on the increase. It increased 33 per cent. between 1899 and 1900, and was more than doubled in 1901, but members of the British Empire League would not grudge the expenditure when they considered how important were the events going on in all parts of the Empire, and when they considered how great was the increase of cable communication between England and her Colonies. He rejoiced with the League to see the practical undertaking of a direct cable, *viâ* Canada and the Pacific to Australia. That would be at least an interesting experiment, and an object lesson between two somewhat different schools of thought. There were some who held that all cable communication and enterprise should belong to private individuals and companies. Others, like Sir Edward Sassoon, held that the principal lines of communication ought to be in the hands of the State. He, personally, did not attach such great importance to the ownership of the cables. What he wished to see was the multiplication of cables in every direction, and that there should be little or no restriction upon the landing of as many cables as possible upon British territory. The more cables there were in existence, the less would it be possible to cut them in time of war; and the more cables there were, the better the chance of getting cheap, economical rates.

The report was adopted.

The Next Electrical Exhibition.—We are informed by the organiser that a good deal of space has already been let for the 20th Century Electrical Exhibition, opening on December 16th at the Westminster Aquarium for six weeks. It is suggested that opening so soon after the closing of the Glasgow Exhibition the opportunity is a unique one for exhibiting in London.

ELECTRO-CHEMICAL INDUSTRIES.

[Abstract of the presidential address delivered before the Society of Chemical Industry at the annual general meeting, Glasgow, July 24th, by J. W. Swan, F.R.S., President.

(*Concluded from page* 211.)

Chromium and its Alloys.—The production of chromium and of chrome-iron at Essen by means of the Goldschmidt-Vautin process is indirectly dependent on an electro-chemical product (aluminium). The Willson Company in America have also been producing ferro-chrome alloy by a direct electric furnace method, and in 1898 they were stated to be making 60 tons of this alloy per month.

Ferro-Silicon.—Ferro-silicon is one of the newer class of alloys now being produced on a commercial scale by the electric furnace. It has been proved that, where there is no excess of carbon, silicon improves some of the physical properties of steel, and that its thermal energy is of value in steel casting.

Scrap-iron, quartz and coke are used as raw materials of the manufacture. The yield in the electric furnace is 1 ton per 5,000 KW.-hours.

Ferro-Titanium.—The manufacture of ferro-titanium is carried on at Niagara.

Scrap iron, titaniferous ore, and aluminium are heated together in a resistance furnace, and the product is sold for use in the manufacture of iron and steel.

Steel.—One of the latest and most startling developments in the field of electro-thermal applications, is the proposal to use electricity in the manufacture of steel direct from the ores of iron. The Stassano process, which has already received experimental trial near Rome, is about to be tested on a considerable scale at Darfo, in Northern Italy, where 1,500 H.P. is available, and an output of 4,000 tons of steel per year is expected.

Phosphorus.—As in the case of sodium, it is probable that in a few years the older method of manufacturing phosphorus will be entirely superseded. In 1899 Tatlock stated that one-half of the phosphorus production of the world (estimated at 1,000 tons) was produced by the electric furnace, and now every country of importance possesses phosphorus works depending on the use of electricity. In this country the Readman furnace is in operation at Wednesfield, and uses about 500 H.P.

Miscellaneous.—There remain to be noted a few miscellaneous uses of the electric current. One of the most interesting of these is the industrial production of oxygen and hydrogen by electrolysis of water. Several forms of cell have been patented, and are in actual operation. In most cases a solution of sodium hydrate is used as electrolyte, with sheet iron electrodes, but in one instance a dilute sulphuric acid solution is employed, with lead electrodes. The cost of the gases obtained in this way of course varies with the cost of power, but at Rome, where current generated at the Tivoli power station is utilised in this manufacture, 1 cb. m. hydrogen and ½ cb. m. oxygen are said to cost only 20 cents. As the cost of hydrogen generated from zinc and sulphuric acid is stated by Schoop to be 2s. per cubic metre, the gain in economy is striking.

Groth's electric tanning process is in operation at Wernersborg in Sweden, and at Wem in Shropshire. The system combines mechanical movement of the hides in the tanning pits, with electrolysis of the tan solution. The present capacity of the plant at Wem is 200 hides per week. The gain in time varies from half to two-thirds of that required by the older method, but some doubt still exists as to the durability of the finished leather.

Finally, I must allude to the use of electricity in the chemical laboratory.

Many metals can be quantitatively determined by electrolytic methods.

Electrolysis can also be used with advantage to prepare standard acid solutions for volumetric analysis. Standard sulphuric acid is now being made in some laboratories by electrolysis of copper sulphate solutions. The chemical laboratory of the present day cannot, therefore, be considered fully equipped unless provided with the fittings and apparatus required for electrolytic work.

The Future.—Are the achievements of the last decade of the nineteenth century but the prelude to still greater developments in the century upon which we have just entered, and will electricity become a yet greater power in the chemical and metallurgical processes of the future? This question requires earnest consideration; it involves interests of national importance, for chemical manufacturers occupy, and have always occupied, a leading place among the industries of our country.

Unfortunately, though we have an abundance of coal, we have very little water in the form available for the economical generation of motive power. Therefore the question comes home to us, whether with coal only, we can carry on electro-chemical industries with profit in competition with the countries which possess a large supply of easily-engineered water-power.

From data gathered from many sources, I find there is one place (in Norway) where power is generated at a cost of 20s. per horse-power year. But, on the other hand, there are cases where water-power costs 10 times, or more than 10 times, this amount. The capital outlay at Lyons has been £84 per horse-power developed, as compared with £3 9s. 3d. at Vallorbe, in Switzerland. Niagara power is a mean between high and low water-power costs; there, the charge to large consumers is at the rate of £4 per E.H.P.-year.

I am informed on good authority that there are steam-power plants in operation in the United Kingdom which yield the power at a cost equivalent to £5 per E.H.P.-year; and certainly there are

many where the cost will be twice and even four times that amount.

Such figures are for power generation on a large scale (not less than 1,000 H.P. units) continuously and uniformly delivered. In the case where the E.H.P.-year is said not to exceed £5, fuel cost only 4s. 10d. per ton delivered at the boilers.

Notwithstanding the fact that under extremely favourable conditions electrical energy can be generated from coal at a comparatively low cost, the fact remains that the greater number of electro-chemical and electro-metallurgical plants are operated by water-power. Summarised, 50 works in Europe have 149,000 H.P. available from water, 16,700 H.P. available from steam, and 250 H.P. from gas.

Great advances have in recent years been made in the direction of reduction of cost by improvements in the steam engine, the gas producer, and the gas engine.

Gas engines of 500 H.P. and even 1,000 H.P. are now manufactured, and work with successful results.

Perhaps it is not wholly futile to inquire whether there is any other way of generating the electricity required for electro-chemical operations. In comparing the cost of electricity produced by mechanical and chemical means it has been usual to emphasise the difference between the cost of coal and of zinc. But even if zinc were as cheap as coal, or if it could be had for nothing, it would still be practically impossible to carry on the electro-chemical industries of the world by means of the voltaic cell as it exists to-day. The cost of the labour and the complication of handling the gigantic cells and keeping them in operation would so far exceed the cost of producing electricity as we now produce it, that we should still continue to use the far more convenient water turbine and steam engine and dynamo, which yield us such great effects with comparatively small apparatus and very little manual labour.

There is the possibility of a more economical way being found of transforming the heat energy of the fuel into electric energy, possibly even on the voltaic principle. But in order to obtain what is required that principle must be employed in a manner widely different from that hitherto attempted in the so-called carbon-consuming cells, or in any of the forms of cell where the electrolyte is a liquid, and the elements are plates that require renewal. I do not pretend to say how it can be done, or that it can be done in any way, but it seems to me that if there is a way it is in the direction of a gas-consuming cell.

For the present it is to be feared and realised that electricity cannot be generated in the British Islands by means of coal as cheaply as in those countries where abundant, accessible, and easily engineered water-power is available, and hence those industries which use a great quantity of power in proportion to the value of the product cannot be carried on with profit in our island. But I trust that gas engines in conjunction with cheap gas may ameliorate the situation, and that at no very distant date blast-furnace gases may be generally utilised for power production, in conjunction with some complementary or auxiliary electro-chemical manufacture.

It is only to the extent equivalent to the chlorine required in commerce that soda can be manufactured by electrolysis as economically as by other means. Electrolytic soda must therefore be treated as the by-product, and chlorine as the principal product, of the electrolysis of chloride of sodium.

Chemical industry is, almost beyond any other industry, liable to change. Twenty-five years ago we possessed well-nigh a monopoly of the manufacture and export of alkali. We well know that that state of things no longer exists. The causes of the transformation are many, and most of them in the natural order of things. But one of the less satisfactory of the causes of change, from the point of view of the British manufacturer, is that non-natural, that quite artificial, cause—prohibitive tariffs, the force of the principle of boycott.

Then there is the great question of education in its bearing on the future prosperity of chemical industry and industry in general.

I cannot but congratulate Scotland and the Scottish Section of the Society on the very advantageous position it occupies in this respect. In England and Ireland we are suffering acutely from dire educational neglect and destitution, and that worst kind of poverty, *insensibility to our deficiencies.*

Our English system of scientific and technical education is not equal to the present needs of the country, seeing how severely we are pressed on every side by the most energetic and intelligent competition. We are giving to the classes at the bottom of the industrial ladder a disjointed smattering of miscellaneous science of no great value, though probably good so far as it goes, while we are neglecting to thoroughly educate those upon whose shoulders will soon rest the weight of the management of our great manufacturing industries. In the present state of things a competent knowledge of the science of the business a man is engaged in as well as an active interest in it, whether it be chemical industry or any other, are essential conditions of any large degree of success in meeting the emergencies of a highly competitive and progressive time. A scientific training of university standard for our manufacturers and for our technical chiefs is an absolute necessity. Surely public money cannot be better spent than in providing adequate facilities for the educational equipment of the men of the future with this essential means of national defence. Our country possesses great stores of mineral wealth, a precious heritage that we are lavishly spending. That gift of nature will certainly not avert, and cannot go far to compensate for, the consequences of neglect of the scientific training necessary to turn our fast-diminishing mineral wealth to the best advantage.

One of the most pressing requirements of the moment, demanded not only in the interest of chemical industry, but in that of our manufacturing industries generally, is *adequate endowment and encouragement of research.* Original scientific research is the fountain-head of new knowledge, the vital stimulus of industrial growth, the originator of new industries and sustainer of old. Yet, nationally, in the organisation of our educational and industrial system, we give to scientific research no hospitality—we barely pay it the respect of recognition.

The advances in knowledge, and the consequent revolutionary changes that have taken place in almost every branch of chemical industry during the last 100 years, are probably not greater than those further changes that will be seen at the end of the present century; for change, brought about by scientific discovery, grows ever swifter and more sweeping.

But change is in the natural order of things, and so long as it is in harmony with progress and improvement, it is to be welcomed—it cannot be resisted. We must prepare to meet it, and we had better meet it on the threshold. But to benefit by it, and to take complete advantage of it, demands the fullest measure of assistance that education, energy and enterprise can unitedly give.

If, as we enter the darkness of the future, we firmly grasp the guiding hand of Science, and, with full faith in her leading, follow her with an alert step, we may go on with the full assurance that we shall be led in the way of prosperity.

Appendix.

A number of tables are appended to the address, giving particulars, so far as they are available, of the power and output of European electro-chemical concerns. By far the greatest power is that employed in calcium carbide works. The following table, though representing only one-third of the existing European works, is of interest:—

Table IX.—*Total Power available in 50 Works in Europe for Electro-chemical and Electro-metallurgical Industries.*

Country.	No. of works.	Horse-power available.			
		Water.	Steam.	Gas.	Total.
United Kingdom ...	6	5,000	8,600	200	13,800
France	11	54,100	Nil.	Nil.	54,100
Germany	9	4,550	5,340	50	9,940
Switzerland	7	25,000	Nil.	Nil.	25,000
Norway and Sweden	4	25,200	"	"	25,200
Austria	2	9,218	10	"	9,228
Italy	5	17,850	Nil.	"	17,850
Russia	4	2,000	2,760	"	4,760
Spain	2	6,400	Nil.	"	6,400
Totals ...	50	149,318	16,710	250	166,278

Expressed as Percentage of the Total Power.—89 per cent. is generated from water, 10 per cent. is generated from steam, and under 1 per cent. is generated from gas.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

15,290. "Improvements in the method of electrically igniting the explosive mixture in hydro-carbon engines." M. H. Smith. July 29th.

15,295. "Improvements in small electric transformers." G. B. Batten. July 29th.

15,322. "Improved liquid starting resistance for electromotors and the like." V. I. Feeny. (Allgemeine Electricitäts Gesellschaft, Germany.) July 29th. (Complete.)

15,335. "Trolley catcher or controller for electric cars." C. I. Earll. July 29th. (Complete.)

15,366. "Improvements in safety devices for electrical apparatus." P. Rudhardt. July 29th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 25th, 1901, being date of application in Switzerland.)

15,368. "A safety device for exposed electric leads." Siemens Bros. & Co., Limited. (Siemens & Halske Aktiengesellschaft, Germany.) July 29th. (Complete.)

15,369. "Improvements in driver's brake valve apparatus for operating air brakes both by means of air pressure and electricity." Siemens Bros. & Co., Limited. (Siemens & Halske Aktiengesellschaft, Germany.) July 29th. (Complete.)

15,370. "Improvements in electric meters for measuring electromotive force or current strength." Siemens Bros. & Co., Limited. (Siemens & Halske Aktiengesellschaft, Germany.) July 29th. (Complete.)

15,371. "Improvements in electric switches." P. W. O. Hodges. July 29th.

15,384. "Improvements in electric conductors and cables." W. E. Hitch. July 30th.

15,385. "Improvements in or relating to telegraph receiving apparatus." A. Marr. July 30th.

15,391. "Improvements in carbon brushes for generators or motors." T. C. Parsons. July 30th.

15,399. "A simple improved clutch mechanism for electric arc lamps." J. Lenderyon. July 30th.

15,412. "Improvements in electric interrupters for induction coils." J. F. Hall-Edwards. July 30th.

15,427. "An improved process for the electrolytic deposition o metals." P. Marino, Q. Marino, G. Marino, and A. Ratchkowsky. July 30th.

15,460. "Improvements in electric clocks." W. L. Wise. (The Actiengesellschaft Magneta, Switzerland.) July 30th.

15,461. "Improvements in electric clocks." W. L. Wise. (The Actiengesellschaft, Magneta, Switzerland.) July 30th.

15,468. "Improvements in secondary battery-plates." B. Kuettner. July 30th.

15,465. "An improved holder for electric incandescent lamps." F. W. Cue and P. W. Paris. July 30th.

15,467. "Improvements in and connected with wireless telegraphy, and other signalling." J. C. Bose and S. C. Bull. July 30th.

15,469. "Improvements in fire alarm contacts." R. Bessel. July 30th.

15,474. "Improvements in systems of telegraphic distribution." P. M. Justice. (The Rowland Telegraphic Company, United States.) July 30th.

15,475. "Improvements in systems of telegraphic inter-communication." P. M. Justice. (The Rowland Telegraphic Company, United States.) July 30th.

15,483. "Improvements in ectric switches." T. W. Broadbent and E. Brook. July 31st.

15,490. "Improvements in unipolar dynamo-electric generators and motors." R. Kennedy. July 31st.

15,496. "Compound electric safety fuse and switch." T. G. Weatherhead. July 31st.

15,499. "An improved glove or hand covering for use in the handling of electrically charged bodies or the like." J. Wilkinson and T. D. Clothier. July 3 st.

15,508. "Improvements in safety devices for overhead electrical circuits." The British Thomson-Houston Company, Limited. (A. H. Armstrong, United States.) July 31st. (Complete.)

15,509. "Improvements in electric controllers." The British Thomson-Houston Company, Limited. (J. B. Linn, United States.) July 31st. (Complete.)

15,514. "Improvements in or relating to electrical primers, vent sealing tubes, and the like." H. T. Ashton. July 31st.

15,517. "Improvements in electric railways." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) July 31st. (Complete.)

15,522. "Improved system of wireless telegraphy with tuned microphone receivers." V. I. Feeny. (Allegemeine Elektricitats Gesellschaft, Germany.) July 31st. (Complete.)

15,524. "Improvements relating to electrically-driven centrifugal blast fans." H. Grull. July 31st.

15,530. "Improvements in and relating to the driving mechanism of automatic electric switches." P. Phieme. July 31st. (Complete.)

15,536. "Improved apparatus for the reinforcing and standardising of filaments of glow lamps." F. Fanta. July 31st.

15,563. "Improvements in fuse boxes for use in connection with the supplying or transmitting of electrical energy." M. Walker. August 1st.

15,573. "Improvements in combined electrical and oxygen therapeutic apparatus." P. H. Baily. August 1st.

15,579. "Improvements in or relating to electrolytic apparatus." A. J. Boult. (The American Alkali Company, United States.) August 1st. (Complete.)

15,598. "Improvements in printing telegraph machines." A. L. Shepard. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 3rd, 1901, being date of application in France.) August 1st. (Complete.)

15,618. "Improvements in electrical instruments." J. Gray and P. Hamilton. August 1st.

15,659. "Improvements in or relating to the lighting of railway tunnels by electricity." G. Westinghouse. August 2nd.

15,664. "Improvements in electric clocks." T. J. Murday and The Standard Time Company, Limited. August 2nd.

15,671. "Improvements relating to dynamo-electric generators and motors." A Churchward. August 2nd. (Complete.)

15,674. "Improvements in the construction of storage batteries." A. Gabitti. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 2nd, 1901, being date of application in Italy.) August 2nd.

15,680. "Improvements relating to dynamo-electric generators and motors." A. Churchward. August 2nd. (Complete.)

15,686. "Improvements relating to commutator brushes for dynamo-electric generators and motors." A Churchward. August 2nd. (Complete.)

15,689. "Improvements in electric incandescence lampholders and switches therefor." J. R. Quain. August 2nd.

15,691. "Improvements in electric railways." C. E. Betts. (I. W. Betts, United States.) August 2nd.

15,714. "Improvements in electric alarms." D. Vial, Jun. Dated August 3rd. (Complete.)

15,753. "Improvements in telephone exchanges." F. Stock. August 3rd. (Complete.)

15,755. "Improvements in or relating to electric governors." H. A. Pryor. (D. C. Smith and R. C. Young, Western Australia.) August 3rd.

15,769. "Improvements in the manufacture of incandescing electric lamps." W. L. Voelker. August 3rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

16,898. "Improvements in pneumatic controlling mechanism for electric railway cars." S. H. Short. Dated August 19th, 1899. Relates to pneumatically operating the electrical controllers on electric railway cars. 6 claims.

16,926. "Improvements in or relating to electric measuring and indicating apparatus." H. Darwen, E. H. Griffiths, and W. C. D. Whetham. Dated August 21st, 1899. Relates to Wheatstone bridges and potentiometers. 5 claims.

16,956. "Improvements in or relating to conduits for electric conductors." J. J. Bate. Dated August 21st, 1899. Conduits of concrete, &c., are formed preferably of oval section, and have the socket flanges flattened above and below to give resting surfaces. Internal bridge-pieces are also provided. The conduit lengths are partially cut through, prior to baking, so as to allow of separation and use as open conduits. The conductors may be set in bitumen vegetable tar, &c. 3 claims.

16,999. "Improvements in magneto-electric telegraphs." L. G. Woolley. Dated August 22nd, 1899. A telegraph transmitter is formed with a spring-driven magneto-electric machine in which the spindle carries a detent arm. The detent arm engages with one or other of the two shoulders in the key lever according to the position of the key. The lever plays between stops, and has a returning-spring. In the receiver an oscillating armature connected to line, carries a rod playing between the stops. The magnet is provided with an insulated sleeve connected by a brush to one line, and also to one end of the armature coil, so that currents of opposite polarity are sent to line on the depression and raising of the key. The receiving-armature strikes one or other of the stops corresponeing to the motion of the key. 5 claims.

17,130. "Improvements in automatic electric alarms." W. Rausch. Dated August 23rd, 1899. Relates to a time-alarm signalling apparatus for hotels, schools, manufactories, &c. The clock is provided with a wheel, each tooth of which acting through the bent lever, completes the electric circuit between the lever and contact. 1 claim.

17,159. "Improvements in electricity meters." G. Hookham. Dated August 24th, 1899. Relates to energy and quantity meters. 6 claims.

17,203. "An improvement in pole-pieces for dynamos." H. A. Earle. Dated August 24th, 1899. Field magnets.—The polar extensions are built up of iron laminæ, the inner and outer edges of which are concentric with the armature axis and the inner surfaces of the poles. These laminæ are held together between two or more rings, to which they are secured by pins. 1 claim.

17,211. "Improved holder for telephones." W. H. Wheatley. (M. Wohlgemuth) Dated August 24th, 1899. Holders for telephones are constructed with a n adjustable support pivoted to the end of an arm which is in turn pivoted to a rod. The rod is pivoted in a fixed arm, and is connected by a spring-controlled l nk with a curved pivoted lever. The pivoted lever is connected by a link with a lever, the inner end of which acts on the yoke slide for moving the telephone hook. The last lever has a notch and a following pawl which engage together when the arm carrying the adjustable support has been moved through a predetermined amount. 3 claims.

17,229. "Improvements in connection with the polishing or finishing of electro-plate and other articles." J. B. Brooks. Dated August 25th, 1899. Burnishing; polishing.—Consists of a process of polishing, burnishing, cleaning, &c., metal articles, which consists in fixing the articles in a rotating drum partly charged with loose polishing material, such as scraps of leather and metal balls, &c. For polishing during electro-plating, the drum is arranged to contain or work within an electrolyte, and the articles under treatment are connected to the plating circuit. 3 claims.

17,256. "Electric log recorder." L. T. Jones, jun. Dated August 25th, 1899. The spindle of one of the arbors of the indicator carries a toothed wheel, which rocks a lever and completes a circuit intermittently for a magnet in a distant indicator. The consequent rocking of a spring armature through a pawl and rachet-wheel, turns the tenths of a knot indicating hand. The spindle of this hand carries a cam, which, acting on the projection of a spring lever, rocks it at each revolution of the hand, and through a pawl and ratchet-wheel, actuates the knots indicating hand. 4 claims.

17,258. "Improvements in or relating to galvanic batteries." A. J. Boult. (J. Trollett.) Dated August 25th, 1899. Relates to a zinc carbon battery, in which the carbon electrode is in two parts, each in the form of a ring, and made up of plates of carbon fitted at their upper and lower ends in crowns of metal. The two parts are connected together at their lower ends by leaden radial bars. The zinc electrode is placed in an annular porous vessel provided with recesses for the passage of the bars. 3 claims.

17,263. "Improvements in connection with electrical measuring instruments employed in combination with current and potential transformers for measuring electrical energy." Siemens Bros. & Co., Limited. (Siemens & Halske, Action Gesellschaft.) Dated August 25th, 1899. Relates to energy for alternating currents. 2 claims.

17,319. "Improvements in grips used in the laying of underground electrical cables." The Steel Nut and J. Hampton, Limited, and S. Hampton. Dated August 26th, 1899. A grip for hauling conductors into tubular conduits is formed with a tapering case, to the inside of which three tapering guides are secured, the outer ends of which form three parallel guides, terminating in a screw box head. The screw working in the head is pivoted in a plate sliding between guides. The plate rests on the heads of three slides provided with toothed inner surfaces for gripping the end of the cable. The outer end of the screw terminates in an eye. 1 claim.

17,337. "An improved battery cell, with double case, applicable also as a Leyden jar." C. Vogt. Dated August 26th, 1899. Relates to the construction of batteries, especially dry batteries, so that they may be transported without being liable to injury from shocks and falls. If the outer casing is made of a conducting material the battery may be used as a Leyden jar. 3 claims.

17,341. "Improvements in or connected with contact apparatus for electric railways with underground current feed and mechanical partial conductor service." C. F. P. Stendebach. Dated August 26th, 1899. Electric railways and tramways on a sectional conductor system with mechanically operated switches. Switches.—Instead of returning the switch to the off position by a spring as described in Specification No. 18,137, A.D. 1898, it is positively actuated. 1 claim.

17,379. "Improvements in electric arc lamps." O. B. Hellstrom. Dated August 28th, 1899. Relates to arc lamps. Carbons are formed as rings in section circular with a flange projecting inward in the plane of the ring. The flanges are held by hinge clips with tightening screws on arms of shafts which are free to turn in frames under the action of gravity, as the carbons are consumed at the lowest parts by the arc. In a modification the carbon rings are supported in a horizontal plane, and are geared to a small electric or spring motor, by which they are slowly rotated continuously. One ring may be replaced by a stationary carbon. 9 claims.

17,386. "Improvements in snap electric switches." M. Guett. Dated August 28th, 1899. Relates to switches giving a quick make-and-break. 4 claims.

17,410. "Improvements in electric accumulators." R. Haddan. Dated August 28th, 1899. The positive electrodes are arranged so that their surfaces lie at an angle to the negative electrodes, so that, in both charging and discharging, the parts of the electrodes of opposite polarity which are nearest to each other are first affected, and then those further apart. The positive electrodes are of square cross-section, and arranged at an angle to the negative electrodes. The positive electrodes may be also of circular or of polygonal cross-section. 1 claim.

17,445. "Improvements in electric cables." G. E. Hoyl-Dia. Dated August 29th, 1899. Conductors are formed of aluminium wire covered with copper or other solderable metal, the insulated strands being enclosed in a thin lead sheath having an outer cover of bituminous, &c., material. The lead sheath may be omitted. 2 claims.

17,474. "Improvements in electric massage apparatus." T. Borndt. Dated August 29th, 1899. A galvanic chain used in massage is composed of zinc and copper plates, with intervening layers of felt, loops and hooks joining the opposite elements of adjacent links. 3 claims.

17,477. "Improvements in mouldings for electric wires and other purposes." M. Chase, De F. W. Chase, G. Code, and E. Planta. Dated August 29th, 1899. The electric wires are inserted in grooves in rabbeted boards fixed to the walls, and are covered by mouldings which are rabetted to interlock with the boards. Metal fastenings or retaining strips, fixed to the boards by screws or spurs, are bent down over the mouldings. 3 claims.

17,504. "Improvements in means and apparatus for recording the deflections of pointers, magnetic needles, coils, and the like, and the fluctuations of electric currents, and for utilising such deflections or fluctuations to actuate or control various other mechanisms or apparatus." E. A. Goddin. Dated August 29th, 1899. Relates to apparatus for recording the deflections of compass needles and other moving bodies, such as pointers, and for the utilisation of such movements for controlling and operating various forms of mechanism and apparatus. The apparatus is stated to be applicable for steering torpedoes and other vessels; regulating the supply of energy, such as an electric current; regulating the supply of matter, such as a mechanical stoker; for use as a telegraph transmitter and repeater; for use as an electro-mechanical type-writer; for use with clocks for controlling other clocks, &c., and for use with pressure gauges and thermometers for controlling and regulating ventilators and fire sprinklers. 7 claims.

17,507. "Improvements in electric lamps with illuminating bodies made of second-class conductors." V. I. Feeny. (Allgemeine Elektricitats Gesellschaft.) Dated August 29th, 1899. Incandescent lamps, having auxiliary heaters for incandescing bodies which are non-conducting when cold are mounted on caps, containing automatic interrupting apparatus for the heater circuits, plates of a bad conductor of heat being interposed to protect the caps. 3 claims.